Performance of Small Engine Driven Generating Units—*An Analysis of Combustion Conditions in Boiler Furnaces with Suggestions to Prevent Clinkers and other articles dealing with station and operating practice.*

Engineering Library

Electrical World

New York, February 10, 1917 McGraw Publishing Co. Inc. Vol. 69, No. 6 10c a copy

FEB 10 1917
UNIV. OF MICH. LIBRARY

THE new knuckle joint provides for desk or wall mounting. Also a new adjustable oscillating 12" and 16" fan. Before signing your 1917 contracts get complete details of our selling campaign.

Western Electric Company
INCORPORATED

Weston

ALTERNATING CURRENT SWITCHBOARD INDICATING INSTRUMENTS

WESTON WATTMETER
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
KILOWATTS
WESTON ELECTRICAL INSTRUMENT CO.
NEWARK, N.J., U.S.A.

Model 167
Single-Phase Wattmeter
(Complete Group described in Catalog 16)

possess superiority so radical that every Consulting or Operating Engineer owes it to himself and his clients to make a careful investigation of this remarkable group of Weston Instruments, and of instruments offered in competition.

The Weston Sales Department and Engineering Staff will assist any members of the profession or prospective users to investigate this important matter.

Weston Electrical Instrument Co.
13 Weston Ave., Newark, N. J.

New York	Chicago	Detroit	St. Louis	Pittsburgh	Winnipeg
Boston	Buffalo	Cleveland	Denver	Toronto	Vancouver
Philadelphia	Richmond	Cincinnati	San Francisco	Montreal	London

Paris Petrograd Johannesburg, S. Africa

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.
Published by McGraw Publishing Company Inc.

Vol. 69 NEW YORK, SATURDAY, FEBRUARY 10, 1917 No. 6

National Engineering Standardization

THE first steps in the direction of machinery standardization, from the engineering rather than the manufacturing viewpoint, were taken by the American Institute of Electrical Engineers in 1898, and the first set of A.I.E.E. standardization rules appeared in 1899. The success of the movement led to its extension, both in this country and abroad. All of the leading countries in the world now have national electrical engineering standardization rules, which define the ratings, qualities and performances of plant and apparatus, without necessarily specifying dimensions or modes of construction. As the work advanced, it was found that standardization could not be effected in electrical engineering without extending into the fields of other branches of engineering, so that it became necessary to form national engineering standardizing committees, with representatives from the principal engineering societies. In Great Britain, for example, the Engineering Standards Committee has representatives from a number of engineering bodies, and it formulates standardizing rules for engineering at large.

It is hoped shortly to complete, in the United States, an organization similar to that which exists in England for general engineering standards. The influence of such an organization, with representatives from all of the engineering bodies, would be very great. It should not only serve to weld and inter-connect the various engineering societies in America, but it should also lend a dignity and prestige to American engineering which, except by collective effort, can never be won. No movement could be more welcome at the present time to the advancement of national engineering and of international progress than one which united American engineering associations into a single standardizing body properly representing all branches.

Getting At Trade Fundamentals

TRADE relations between manufacturer, jobber, central station, dealer and contractor have few determining lines of policy to-day. The industry is awake to the need of better merchandising methods, but the policies which underlie methods have not been discussed enough by the leaders of the industries. A stable trade in electrical merchandise, in our opinion, will never be developed until each party in the chain between the manufacturer and final customer realizes that each must have a chance to make his legitimate profit for the service he renders. It must pay each man in the chain to be in the electrical business or he cannot last.

The dealer who competes locally with the central station that cuts prices indiscriminately can never be a merchant. The jobber who takes the credit risk and assumes the stock-carrying charges as a middleman must get his profit. The manufacturer who has to adjust his prices to meet the demands of a jobber who is also a retailer is at a disadvantage. These questions exist in other industries. In the electrical business there is an unusual opportunity to establish real trade-building policies. We have contractors' and dealers' organizations, central stations, jobbers' and manufacturers' associations. But the real trade discussion between the leaders in these organizations seldom takes place. The ELECTRICAL WORLD believes that each of these associations is working too much by itself on detail situations, all good, but with few connecting threads of policy that tie the whole industry together. Representative jobbers should discuss trade and commercial relations at central station conventions, contractors should be heard in manufacturers' meetings, central stations should be heard in contractors' meetings. The trade and merchandising methods are being discussed in detail by detail men, but the trade and merchandising policies which underlie methods need the thought of the leaders in every group.

Graphical Presentation of Wire Properties

ELECTRICAL men are much interested in wires and their properties. Even so-called "wireless" men use wires extensively in their radio constructions. Wires possess mechanical, electrical and thermal properties. These properties need to be expressed in units of some kind. In the world at large there are two kinds of units, namely, scientific or civilized units, and unscientific or uncivilized units. The scientific units are the international metric units. The unscientific units are the British, American, Turkish, Arabic and other varieties. Sooner or later all of the world will adopt the international metric system.

For the inter-comparison of the properties of wires in metric and in non-metric units, tables or charts are desirable. Among comparison tables are the wire tables of the U. S. Bureau of Standards and the tables of H. M. Hobart. The article by Andres Ham, which we print this week, offers a convenient chart for presenting the same comparison graphically. For American wire gage the lines on such a chart have the advantage of being simple, straight lines. A chart of this kind is useful for reference, even when there is no need to transfer from metric to non-metric units or vice versa.

A Dummy Antenna for Testing Radio Units

WHEN electrical engineers test a dynamo machine they are not likely to disturb engineering operations in other buildings, or even in other parts of the same building. When, however, they test a radio plant of considerable power they are likely to disturb the ether for hundreds of kilometers in all directions. A need arises, therefore, for a dummy antenna, or a radio load for testing radio generators, which shall not seriously stir up and vex the ether in the vicinity. The problem is to load the generator but to suppress the output beyond a short range. This is a problem in radio inefficiency, and is just the reverse of the ordinary problem of the radio engineer, which is to load his generator as efficiently as possible, so that the effects may be manifested at a great range.

The article on page 278 describes a dummy antenna at Palo Alto, constructed by the Federal Telegraph Company. It consists evidently of a bed of horizontal galvanized iron wires in five layers, so arranged as to be capable of forming an air condenser of adjustably variable capacitance up to about one-thirtieth of a microfarad. With such a capacitance carrying 250 amp. at 20,000 cycles per second, the voltage, neglecting all losses, would approximate 64,000. Sixty-four kilovolts driving 250 amp. in quadrature would develop 16 megawatts of reactive power. An active power rating of 200 kw. would thus only demand a little more than 1 per cent of dissipation factor. It is evident that this dummy has large dissipation possibilities.

Uniflow Engine Economics

THE article in this issue by E. Hagenlocher on the use of the uniflow engine in electric plants gives our readers a welcome idea of the present state of development of this particular type of reciprocating engine. The principle of the machine is well known, the fundamental purpose being to lessen the temperature variations which produce condensation in the steam cylinder by causing the steam flow to maintain a uniform direction with respect to the cylinder walls instead of alternating high and low temperatures. The steam enters the cylinder at the heads and is exhausted in the middle, producing an economy equivalent to that obtained from multi-cylinder engines of moderate rating, but in a far simpler and less costly form. It would be interesting to know, although difficult actually to measure, the cylinder wall temperatures and the lowered condensation secured by this design, since it seems, in the engines here described, to have been worked out in an efficient and scientific manner. The use of the poppet valve, for instance, is a step toward efficiency, particularly if superheated steam is to be used, and a large area of exhaust port also tends to improve the thermodynamic conditions. The results which Mr. Hagenlocher quotes certainly speak well for the designing skill that has obtained from a small and comparatively simple engine, results which would be creditable to ordinary compound engines of considerably greater output. The performance, too, may well challenge comparison with that of turbines of similar size, and if run non-condensing the difference would be still more noticeable. As indicated by the figures before us, the uniflow design seems to give specially favorable results at low and moderate loads, a particular point of excellence for which the steam turbine has earned a reputation. There seems to be no doubt that the great use of the turbine has been a very valuable stimulant in producing improvement in the design and performance of reciprocating engines, so that the latter, especially in the smaller sizes, seem to have taken a new lease of life. Data like those presented are a good indication that progress is still possible along this and other lines to improve fuel economy, which is the goal of modern steam engineering. The saving in coal shown in the example given by Mr. Hagenlocher is particularly striking, since the comparison is between a modern high-efficiency uniflow engine and those of more common type, all operated non-condensing. Such conditions represent a type of plant which in no small number of instances has to be used owing to local conditions. It is the small plant operated under variable load which is notorious for high steam consumption, and the present improvement, directed to remedying that condition, is therefore all the more important in practice.

Naval High-Powered Radio Stations

THE opening of the new naval radio station, located just outside of San Diego, Cal., marks the latest step toward the completion of the ambitious plans formulating for some years past. It will be remembered that when the Arlington, Va., naval radio plant was put into service four years ago it was not only the strongest wireless station in the world, but the first of a projected series of powerful installations. It was intended for direct trans-oceanic and trans-continental naval radio service, and, with the distant stations to be erected at various outlying points, was to provide instantaneous communication from Washington to any of our war vessels on the Atlantic or Pacific. Arlington's range has, in fact, extended from Panama to Nova Scotia, and from Gibraltar to the Pacific Coast. Until the San Diego plant was put in commission a few weeks ago, however, there was no naval radio station on the West coast which had sufficient power to work reliably across the continent to Arlington.

The San Diego transmitter is one of a group of five new high-powered sustained-wave plants using arc generators, and is rated at 150 kw. This is nearly as large as the great Sayville station which has been used to communicate with Germany. Not long ago it was thought impossible to build arc oscillators of such large input power, and even yet the efficiency of these enormous gas-discharge converters is held by some authorities to be necessarily low. Nevertheless, American commercial radio-engineering development has produced still larger arc generators, whose rated input power runs as high as 350 kw. Record-breaking apparatus of this sort is to be used in the naval radio station now building at Cavite, P. I., for direct communication with the North American continent.

When the projected plants in Hawaii, Guam and Alaska are opened and placed in wireless connection with Cavite, Panama, San Diego and Arlington, our Navy Department will be well started on its world-embracing communication scheme. The next step will be to build up, demonstrate and maintain reliability of service, for unless messages can be sent through under practically all conditions the system will not have that dependability which is so necessary in commercial and proper military operations. On the opening day, San Diego is reported to have communicated with Panama, Alaska, Arlington and Australia, over distances up to 6000 miles. This argues well for the station's effectiveness; continued ability to communicate over such vast spans of land and sea must not only be hoped for but secured, if the expense of the stations is to be justified.

Daylight Saving

DAYLIGHT saving possibilities have now passed from interesting suggestions to strong probabilities. The convention just closed has made it evident that there is throughout the country, and especially from boards of trade and chambers of commerce, a considerable demand for at least trying out the plan as quickly as possible, and that there will be vigorous pressure for the passage of the Borland Bill before the end of the present session. Whether it can be pushed through in the short time now remaining is another matter. The interesting feature of the discussion is that so far no organized opposition has shown itself, and in default of this there is no brake upon legislative action. The present sentiment seems to be a spontaneous manifestation, and the only objectors so far have been a small conservative body of astronomers whose influence in legislative matters is negligible, and a certain section of the lighting supply companies whose opposition is viewed with suspicion by the man on the street.

Looking at the proposition in perfectly cold blood its effect on the lighting industry does not seem likely to be great except perhaps in some strictly local manifestations. If the plan should be put through to take effect, for example, from May 1 to Oct. 1, it is dealing with a part of the year in which the lighting load of central stations is relatively small, and of this load only a portion is likely to be affected. The results would be chiefly manifest in a diminution of the residence lighting, itself rarely in a considerable percentage of the output, and even here the load would probably be cut by only a very modest amount, the loss of which ought to be easily recouped by additions to the appliance and miscellaneous service.

A striking feature of the discussion was the fact that the questions raised were not regarding the desirability of the movement, but chiefly with the particular way in which it should be applied. Some early rising enthusiasts were anxious to have the change carried throughout the year. Obviously a very little experience with going to work while the street lights were still burning of necessity would affect an automatic cure of this perfervid desire for early rising. Our country extends over so wide an area north and south that any change of clocks must be made rather cautiously to avoid overdoing it along the northern border. The soundest argument advanced was the extra time given for recreation by the artificially lengthened day, which probably accounts for the active co-operation on behalf of some of the labor interests. Another argument advanced based on the probable lessening of eyestrain by the change seems quite unwarranted by the facts, since within the months in which daylight saving could be carried out without losing as much at one end of the day as one could gain at the other, the amount of work done by artificial light is very small, and the only period within which the use of the eyes would be greatly reduced either in business or pleasure would be after the clocks were put back to their normal place.

It will be difficult in a country governed as is our own to get a consensus of opinion to enforce the change. After the present time-belt system was formally adopted, largely by the influence of the railroads, it took some years to make the change of the clocks anything like universal, and indeed some places even now rejoice themselves in two or three kinds of time after the lapse of more than thirty years. Of course, legislation for the change in all matters with which the United States government has to do, including interstate railways, would practically push the system into use if backed up, as seems to be the case, by local enthusiasm. Yet it might be a long time before it became universal. It must be borne in mind that the conditions in this country are quite different from those in the European countries which initiated the change, and that conclusions drawn from its effects noted during the last summer are disturbed by the entrance of many factors which have nothing to do with the case. That the clocks can be set forward and backward without any particular difficulty as regards public convenience seems, however, to be well demonstrated.

Coming Issues

IN the next issue of the ELECTRICAL WORLD a leading article by Prof. Alfred Still will take up the technical and engineering problems involved in the design of high-tension terminals and bushings to meet operating conditions of transmission systems. Other articles will discuss other engineering problems from technical and scientific viewpoints. The issue dated Feb. 24 will, as usual, contain articles dealing particularly with the commercial side of engineering problems. One article will take up a plan for graphic analysis of load factor improvement. In the first issue for next month, dated March 3, matters of public policy and the broader phases of problems in the management of public service properties will be discussed. The next issue of ELECTRICAL MERCHANDISING will be issued on the 15th of this month and will present selling suggestions worked out especially for spring house-wiring campaigns, together with a new department on store equipment for the electrical dealer.

Characteristics of Uniflow Engine Generating Units

Features of Construction and Performance Characteristics of Uniflow Engines, and Fields of Application in Which They Show High Operating Economy

BY E. HAGENLOCHER
Member Engineering Staff J. G. White Engineering Corporation

THE economy effected by the use of the uniflow engine in power stations of moderate size is far greater than the average engineer will imagine unless he has kept constantly in touch with the most recent developments. For this reason the writer has assembled in what follows here the main features of uniflow engine applications, designs and operating characteristics, together with test data. By the uniflow engine is meant that construction which makes use of the uniflow or central flow of steam through a cylinder. That is, steam is admitted at the ends of a cylinder, expanded and discharged through ports midway between the cylinder heads. The ports are uncovered by the movement of the cylinder piston as an exhaust valve during its travel. The construction is shown in Figs. 2, 3, 4 and 5. Since the steam is exhausted at the middle of the cylinder, the cylinder heads are always maintained at the temperature of the live steam entering and the central part at the temperature of the exhaust steam.

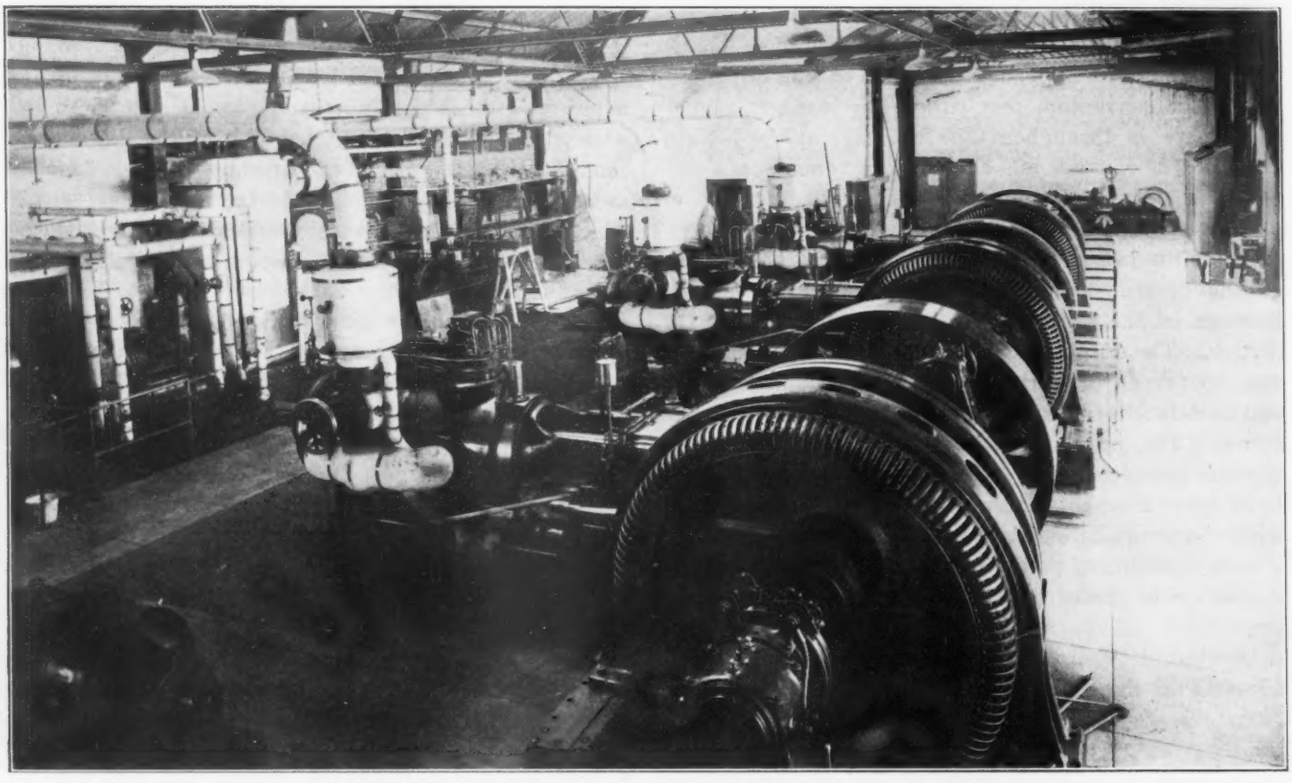


FIG. 1—THREE 21 BY 22-IN. UNIFLOW ENGINES OPERATING CONDENSING AND NON-CONDENSING IN WOODHAVEN (L. I.) MANUFACTURING PLANT

The main reason for the uneconomical performance of the simple one valve engine is found in the large amount of steam condensed during each stroke. This design has therefore been best adapted to low pressures and temperatures. The condensation is due in part to the excessive clearance spaces and surfaces in the steam passages, and to the total range in temperature alternately heating and cooling the cylinder walls. Further limitations of the slide valve are that the advantages incident to the use of superheat can not be obtained on account of troubles due to warping, lubrication and leakage due to dryness of high-temperature superheated steam.

The design of the four valve engine shortened up the steam passages and thus reduced the condensation by a certain amount. The Corliss type of valve is suitable only for slow speeds, while the poppet valve type is now the nearest single cylinder competitor to the uniflow design on account of the high pressures and temperatures which can be used.

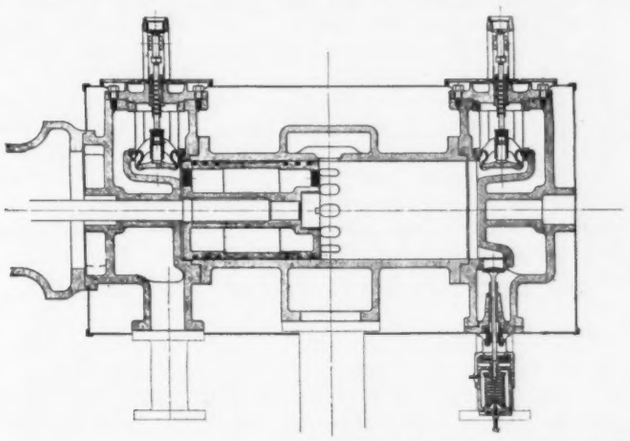
The multiple expansion engine obtains its high efficiency by the reduction in the range in temperature to which the walls of each cylinder are subjected.

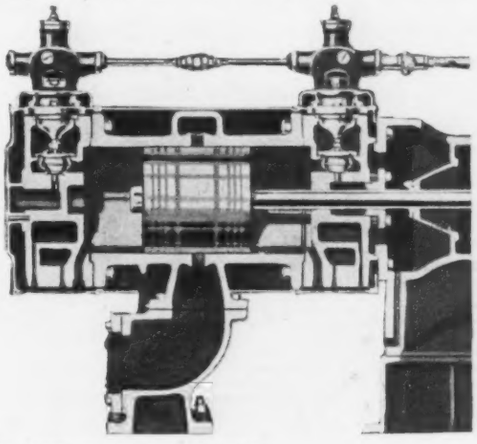
The uniflow engine reduces condensation by not allowing the low temperature exhaust steam to cool the portion of the cylinder walls and clearance spaces which come in contact with live steam. This action is more fully described later. Steam passages are also reduced to a minimum and valves are used which will permit the use of high temperature and high pressure steam. On account of the uniflow or central flow principle of operation, the temperatures of the cylinder heads and clearance surfaces in this design are high on account of the heat of compression raising the normal temperature. These two factors are the principal ones which contribute to the economy of the engine, and make possible results which are better than those obtained with four valve engines and comparable with those obtained from compound and multiple-expansion engines.

JACKETING OF UNIFLOW ENGINES

The heads and ends of the cylinder up to the point of cutoff are usually jacketed with live steam when operated on steam having little or no superheat. For

higher pressures and superheat less steam jacketing is necessary. The greatest amount of condensation takes place at the piston surface, which in most cases is not steam jacketed. Any steam that may have become wet by coming in contact with the piston is necessarily near the exhaust ports and is therefore expelled with each stroke of the engine. The steam trapped for the compression part of the stroke is comparatively dry and receives heat from the jackets and from compression. Jackets need to be thoroughly drained to prevent accumulation of condensation in them.





FIGS. 2 AND 3—SECTIONS OF NORDBERG AND AMES UNIFLOW ENGINES

Uniflow engines are governed by changing the lift of the poppet valves, which is accomplished by increasing the throw of eccentrics. Some governors are mounted in the flywheels while others are on the lay shaft, alongside the cylinder, which drives the eccentrics. It is of great advantage to have governors which are adjustable while running, where several engines, connected to alternators, are to be synchronized and paralleled.

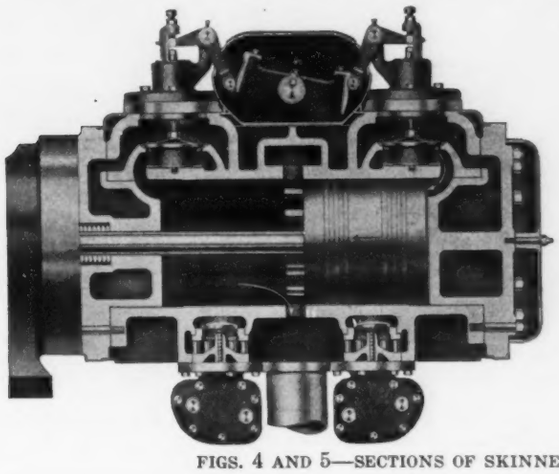
INLET VALVES OF UNIFLOW DESIGNS

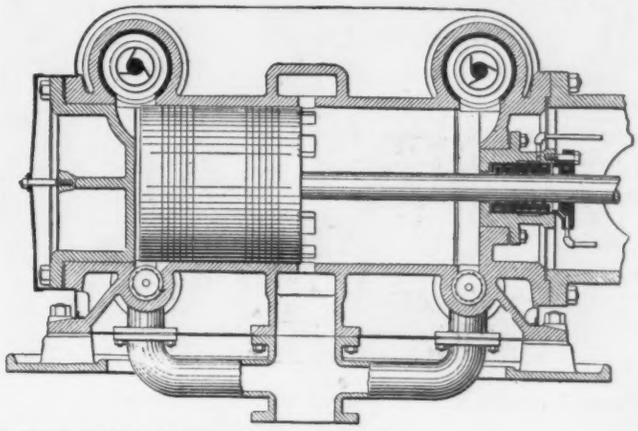
The main differences in the uniflow engines on the market to-day appear to be in the arrangement of valves, valve gear and methods of adapting the engines to condensing and non-condensing conditions. The inlet valves may be of any type—that is, poppet, Corliss, piston, slide, etc.—but are more commonly poppet type on account of the quick opening and closing features and adaptability to high temperatures. The poppet valves are usually of the balanced type, designed with the view of having them tight under all conditions of temperature and load. This requires that they be made either with the seats expanding at the same rate as the valve body or made in such a way that the parts of the valves are separate and self-adjusting. It is very necessary that the inlet valves remain tight as in the uniflow engine compression extends over a large part of the stroke, about 90 per cent, and any leakage will tend to increase the pressure to a higher point than desired, in addition to requiring more power for compression. When poppet valves are used they are operated either by cams connected through bell cranks or straight rods to the eccentric on the main shaft or directly by cams mounted on auxiliary shafts parallel to the piston travel.

It is essential that there should be as little lost motion as possible in the valve gear, as even the maximum opening of the poppet valve is quite small and at very light loads the motion of the valve stem can hardly be detected. Therefore it would seem that the most direct motion is the most desirable from the standpoint of keeping its regulation and economy maintained after years of service.

EXHAUST VALVES FOR UNIFLOW CONSTRUCTION

As already mentioned, the exhaust is usually taken through ports extending around the middle of the cylinder, with the piston acting as the exhaust valve. The use of a ring of exhaust ports around the middle of the cylinder allows the area of the exhaust ports to be several times that obtained by using other forms of valves. This aids greatly in quickly bringing the cylinder pressure down to that of the exhaust, and is quite necessary because the duration of the exhaust is less than in the counterflow engine.





FIGS. 4 AND 5—SECTIONS OF SKINNER AND YORK POPPET-VALVE UNIFLOW ENGINES

Auxiliary exhaust valves are sometimes provided to reduce the amount of steam being compressed when running non-condensing. One type of engine changes the amount of steam compressed from condensing to non-

condensing operation, when the vacuum fails, by the automatic operation of these valves with additional valve gear, which delays the point at which compression starts. Another accomplishes a similar result with self-acting valves, which increase the clearance spaces for the latter condition.

The auxiliary exhaust valves which are operated by

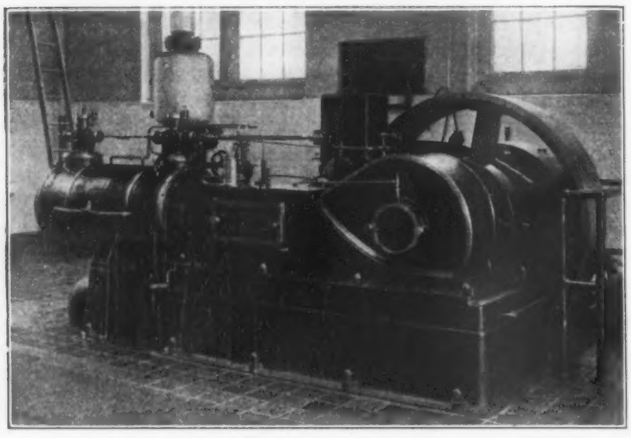


FIG. 6—NON-CONDENSING 17 BY 20-IN. UNIFLOW-ENGINE INSTALLATION

valve gear are also poppet type, but they do not need to be balanced as they are opened only when the pressures on the two sides are equal. At light loads and at starting there is a tendency for these to create noise due to the expansion of the steam being so great that the pressure is less inside the cylinder than outside, allowing these valves to lift. Those types of auxiliary valves which act without valve gear increase the clearance volume or eject the steam in case the compression becomes too high.

Location of Inlet Valves

One of the important differences in designs of uniflow engines now on the market is the manner in which the inlet valves are placed relative to the cylinder. In one design the valve casings are a part of the cylinder, in another a part of the heads, and in still others they are removable, and located either in the ends of the cylinder or in the heads. The valves are placed either with the stems vertical or horizontal, and usually at right angles to the piston rod.

Condensing and Non-condensing Operation

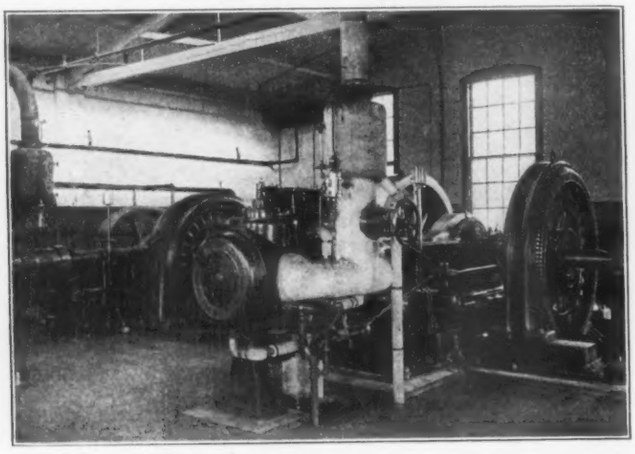
Low boiler pressure or high back pressure requires greater clearance in uniflow engines, and this tends to reduce the economy. In order to get compression equal to the initial steam pressure, a less volume of steam is required while running non-condensing than for condensing, because of the greater density of the latter. This means that a non-condensing engine must have more clearance or the amount of steam for compression must be reduced. For an engine with a fixed low clearance auxiliary valves are necessary to delay the point at which compression starts. Where clearance pockets are provided the additional steam can be compressed in these to prevent excessive pressure. A higher economy is probably obtained by the former method at an expense of additional valve gear. In the latter the conditions reduce the economy about in proportion to the clearance pockets. Engines built for non-condensing service are usually fitted with pistons of a special pattern, such as concave face, which give more clearance without the necessity of changing the cylinder.

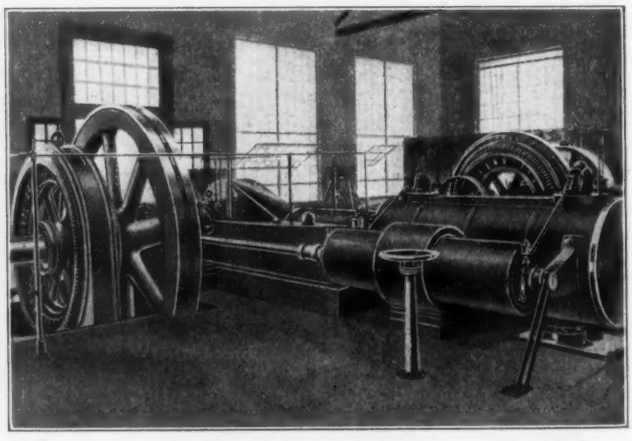
Speed Regulation of Engines and Parallel Operation

The regulation of a uniflow engine is usually much better than a counterflow. There are engines on the market that will easily regulate within one revolution in 200 from one-quarter load to full load. At very light loads the speed is likely to be somewhat variable, but if there is a constant dead load, such as friction and windage of a direct-connected generator, this trouble will not be noticeable unless the generators are of the alternating current type, in which case there may be difficulty in synchronizing.

At very light loads, especially if the machines are running in connection with condensing equipment, there is an unstable condition presented where the speed is liable to change, which makes it difficult to synchronize. Difficulties have been encountered with three engines working together under equal loads. They may continue to operate satisfactorily for an hour or so, then when a slightly heavier load is required they will take it very unequally, perhaps to such an extent that two of the machines may throw the third one out. It has been found necessary in one installation where flywheel governors were used to put motors in the flywheels so that the speeds could be changed with the engines running.

Parallel operation of uniflow engines with older types of steam engines has been accomplished without any difficulties in many installations that have been made.





FIGS. 7 AND 8—A 17 BY 20-IN. UNIFLOW ENGINE RUNNING NON-CONDENSING IN A BAYONNE (N. J.) COTTON-WEAVING MILL; AND A CENTRAL-STATION UNIFLOW-ENGINE INSTALLATION AT BARSTOW, FLA.

Maintenance of Equipment

Due to the newness and undeveloped state of this type of engine, statements as to present maintenance should not be considered too seriously, as the troubles that are now arising are being rapidly overcome. It may be

expected that the higher the superheat the greater the maintenance on account of difficulties incident to lubrication and packing. Most of the engines which have come to the writer's attention have operated for a year without any maintenance. On others there have been troubles consisting of governor adjustments for synchronizing and load division troubles, need for eliminating noise at light and heavy loads, piston rod packing, cylinder replacements, and need for increased strength of valve gear.

It should always be recognized that for the best operation the additional cost of having a good engineer in charge will usually be more than returned by savings in maintenance and fuel, as the poppet valve gear must be kept in adjustment to maintain uniform economy.

Essential Points When Testing

Temperature due to a preceding load is a very important factor affecting economy, as considerable time, compared with the period of testing, is required to obtain the proper constant temperatures for a load. This is a point usually undervalued, as test runs are often made as rapidly as possible, and since accurate tests for a certain load condition can be made in less than five minutes if the equipment is adequate. Drainage water from steam jackets should be considered as adding to water rate of engine. Quality and pressure of steam must be kept constant and at the proper value. Adjustment of valves should be made as equal as possible. Indicators should be used to check the pressure gages in the steam and exhaust lines.

If tested with an alternating-current generator and water box load care should be taken to calculate efficiencies of the generator at 100 per cent power factor and correct the results of pounds of steam per kilowatt-hour obtained for 80 per cent power factor efficiencies if the guarantees are made on the latter basis.

Variations from Standard Conditions (Corrections)

The guarantees of some manufacturers give the following corrections for variations in steam conditions:

For each pound of back pressure in the exhaust additional to that of the atmosphere, the steam consumption should be increased about 0.6 lb. per indicated horsepower-hour for pressures of about 125 lb. per square inch and 0.5 lb. for pressures around 140 lb. per square inch.

If superheated steam is used instead of saturated, reduce the consumption at all loads, both for condensing and non-condensing operation about as follows:

50 deg. superheat	1.75 lb. per indicated horsepower-hour
75 deg. superheat	2.25 lb. per indicated horsepower-hour
100 deg. superheat	2.50 lb. per indicated horsepower-hour
150 deg. superheat	3.00 lb. per indicated horsepower-hour
200 deg. superheat	3.25 lb. per indicated horsepower-hour

Corrections for Pressure Variations

The increase in economy due to an increase of pressure is greater at lower pressure than at higher. This increase is not so great with condensing as with non-condensing operation. The following approximate figures will illustrate these points, which refer to average loads for one make and size of uniflow engine:

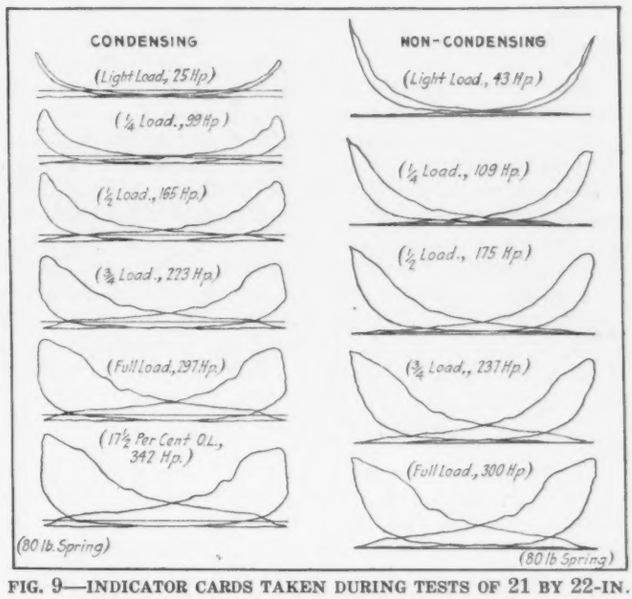


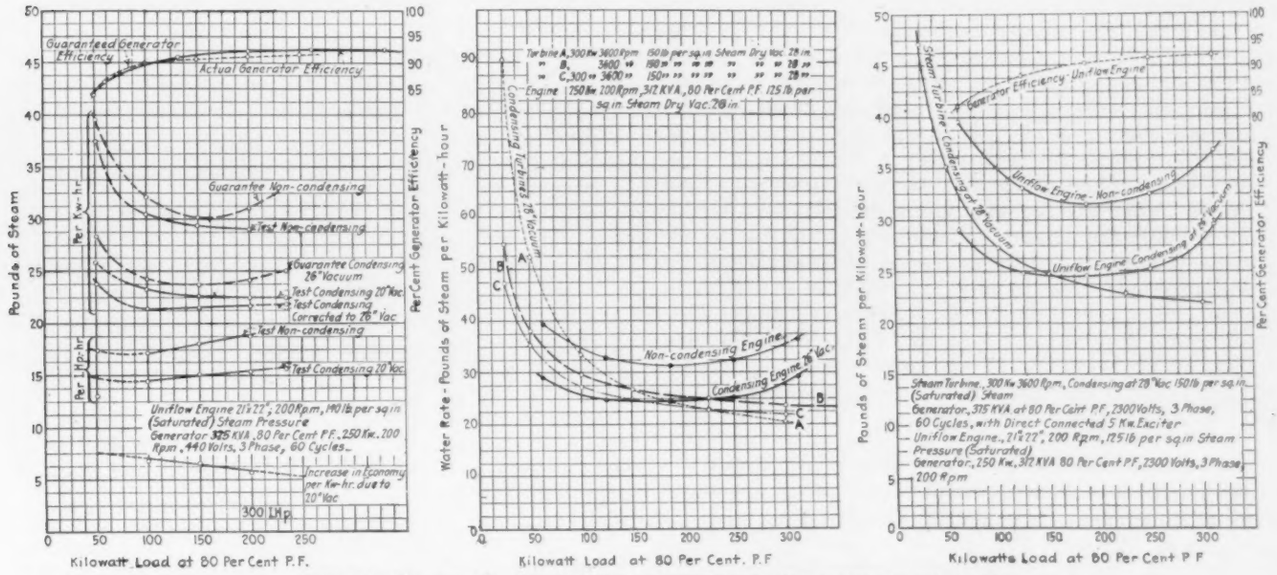
FIG. 9—INDICATOR CARDS TAKEN DURING TESTS OF 21 BY 22-IN. UNIFLOW ENGINE, THE PERFORMANCE OF WHICH IS SHOWN IN FIG. 10

Pounds of Steam per Indicated Horsepower-Hour

Pounds per Square Inch	Non-condensing	Condensing
100	21.5	15.5
125	19.5	14
140	18.5	13.5

Corrections for Vacuum Variation

The following corrections were made for the engine whose curves are shown in Fig. 10. Although these corrections may not be absolutely accurate, they are the best that could be applied at the time and are more


Guaranteed Generator Efficiency
Actual Generator Efficiency
Guarantee Non-condensing
Test Non-condensing
Guarantee Condensing 28" Vacuum
Test Condensing 27" Vac
Test Condensing Corrected to 28" Vac
Test Non-condensing
Test Condensing 27" Vac
Uniflow Engine 21"x22", 200 Rpm, 140 lb per sq in (Saturated) Steam Pressure Generator 325 KVA, 80 Per Cent P.F., 250 Kw., 200 Rpm., 440 Volts, 3 Phase, 60 Cycles.
Increase in Economy per Kw-hr. due to 27" Vac
300 I.H.p.
Pounds of Steam
Per Kw-hr
Per I.H.p.-hr
Per Cent Generator Efficiency
Kilowatt Load at 80 Per Cent P.F.
Turbine A, 300 Kw 3600 Rpm 150 lb per sq in Steam Dry Vac. 28 in.
Engine 750 Bhp 200 Rpm 312 KVA, 80 Per Cent P.F. 175 lb per sq in Steam Dry Vac. 28 in.
Condensing Turbine
Non-condensing Engine
Condensing Engine 28" Vac
Water Rate - Pounds of Steam per Kilowatt-hour
Kilowatt Load at 80 Per Cent. P.F
Steam Turbine - Condensing at 28" Vacuum
Generator Efficiency - Uniflow Engine
Uniflow Engine - Non-condensing
Uniflow Engine Condensing at 28" Vacuum
Steam Turbine, 300 Kw 3600 Rpm, Condensing at 28" Vac 150 lb per sq in. (Saturated) Steam
Generator, 315 KVA at 80 Per Cent P.F., 2300 Volts, 3 Phase, 60 Cycles, with Direct Connected 5 Kw. Exciter
Uniflow Engine, 21"x22", 200 Rpm, 125 lb per sq in Steam Pressure (Saturated)
Generator, 250 Kw., 312 KVA 80 Per Cent P.F., 2300 Volts, 3 Phase, 200 Rpm
Pounds of Steam per Kilowatt-hour
Per Cent Generator Efficiency
Kilowatts Load at 80 Per Cent P.F

FIGS. 10, 11 AND 12—ECONOMIES OF TURBINES AND UNIFLOW ENGINES

Guarantee and test performances of 21-in. by 22-in. uniflow engine; comparisons of uniflow engine with three competitive turbines; and guarantees of units for a plant, the performance of which is given on page 264. The water rate for the turbine in Fig. 12 includes excitation.

likely to be insufficient rather than too great. The values of economy obtained in condensing tests at 20 in. vacuum were subtracted from those obtained in tests made at the same time with exhaust at atmospheric pressure. The differences were plotted and form the curves shown at the bottom of Fig. 10. This shows the benefit derived from 20-in. vacuum, and other pressures were considered to be in proportion. An average value for each inch of mercury is about 0.3 lb. per kilowatt-hour.

Field of Application

The uniflow engine at present competes for all positions in the entire field of the steam engine in sizes up to approximately 500 hp., and is approached in economy only by multiple expansion engines and recent types of four-valve engines. It is capable of quite high overloads without a great increase in steam consumption, and is therefore suitable for service where the loads are subject to wide fluctuation, such as electric power for both lighting and traction, rolling mill service and general power. Also for load conditions such as occur in refrigeration, where the unit would be so small that a multiple expansion engine would not be considered on account of its high initial cost. For mixed service—that is, condensing and non-condensing operation—the uniflow engine is preferable to the turbine, and for condensing operation it is a close competitor.

In places where economy is not of prime importance there is no particular advantage to be gained by this type, as there is no doubt that more development is needed to make it as universally applicable and inattention proof as the counterflow with its more rugged mechanism.

If exhaust steam is used at all times there will be less additional benefit derived from the uniflow design over others. In a great many cases exhaust steam is used for heating during cold weather only, and here the advisability of using a uniflow engine would depend upon the particular installation. Some engines are equipped with a device which will automatically accommodate the engine to the required conditions of exhaust. This device is of great help in maintaining good economy in a plant which runs under such varied conditions as condensing in the daytime and non-condensing at night. When engines are run condensing during certain seasons only it will pay to change pistons if the engines do not change over automatically.

If the plant is to be run condensing, however, it will be found that the uniflow has great advantages, because the equipment can be smaller as a result of its economy with a consequent saving in fuel, reduction in upkeep and smaller boiler room. If non-condensing and the exhaust is not to be used, there will be a saving in boiler room, equipment, fuel and water.

The space taken up by the uniflow is not materially different from that of the single cylinder counterflow engine, while the smaller space taken up by the turbine will be of advantage in some cases. In the case of the installation referred to later, the engine could be included in a space 15 ft. by 20 ft. approximately, while the turbine required but 5 ft. by 16 ft. The additional length of the cylinder is the principal change in the dimensions of a uniflow compared with a single cylinder engine of the counterflow type.

Load Conditions

Since the low steam consumption per horsepower-hour at light loads (one-quarter load) is practically the same as at full load, this engine is eminently suitable for use in plants that run a considerable length of time at low loads, and it is in this field that the engine has become most popular. In steel mills the load factor is very low and an engine of this type is desirable.

Many central stations and isolated plants have a low-load factor, whereas manufacturing plants usually have a steady load. It would appear, therefore, that in the latter case the advantage of the uniflow would not show to such a great extent. However, in these plants it often happens that one engine is kept running at night to supply a very light load, and it will be economical to use one of the large uniflow units for the light loads, because the necessity for having a small auxiliary machine is eliminated.

Analysis for Determining Exhaust Conditions

To decide between non-condensing and condensing operation requires the same analysis that is used for other types of engines, as shown in the tabulation below:

Relative Advantages and Disadvantages of Condensing Operation Over Non-condensing

First cost	Higher
Life in years	Shorter
Interest on amortization fund	Higher
Interest on capital	Higher
Taxes	Higher
Yearly cost of operation	Lower
Yearly cost of maintenance	Higher

Analysis of Economies and Operating Results

When considering results of operation or test, the following points should be looked into very thoroughly:

Kind of coal being used.
Exhaust conditions (back pressure or vacuum).
Steam conditions (quality and pressure).
Distribution of load between units of various sizes and types.
Periods of light and heavy loads.
If economy is expressed in pounds per kilowatt-hour, the efficiency of generator, including excitation and rheostat losses, friction and windage of generator (if direct connected), should be charged to the engine.

Since most operating figures are given in terms of the coal used they will depend greatly upon (in addition to the above) the method of firing and condition of boilers, efficiency of auxiliary apparatus, etc.

The results which follow were obtained in an electric light plant, which, in 1915, operated the following equipment:

Unit No. 1—150-kw. simple non-condensing engine, direct connected to a 2300-volt generator.
Unit No. 2—70-kw. simple non-condensing engine, direct connected to a 2300-volt generator.
125-hp. boiler H.R.T. 125 lb. per square inch.
254-hp. boiler W. T. 125 lb. per square inch.

These units were used practically all the time in 1915.

Unit No. 3, a 250-kw. uniflow engine, was installed in 1916 for non-condensing operation. Slight changes were made in the boiler room consisting of the installation of a balanced draft system, blower, soot blower and increasing the combustion chamber by lowering the grates. Unit No. 3 carried practically all the load during this period, with No. 2 helping a few hours each day on the peak.

OPERATING RESULTS FOR THE PLANT CONSIDERED

	Month of October		Ten-Month Period	
	1916	1915	1916	1915
Total kilowatt-hours generated	75,830	49,900	538,870	404,134
Peak kilowatts (see note)	318	197	318	209
Load factor—hourly average in per cent.	32	34	22.8	26.7
Pounds coal per kilowatt-hour	5.49	13.7	6.64	12.5
Total coal burned (tons—2000 lb.)	212.3	342.6	1760.3	2537.3
Cost of fuel	$595.34	$993.79	$4,732.21	$7,621.55
Generating cost per kilowatt-hour	$0.0163	$0.0285	$0.0192	$0.0300

Note: Coal used was Susquehanna bituminous at $2.818 per ton.
Peak kilowatt—average of difference between watt-hour readings for one hour.

From the above it will be seen that, for the same ten-month period, the coal saved in 1916 over that used in 1915 amounted to $2,880, or $3,460 per year. This is at a rate which will pay for the engine and its installation in less than two years' operation.

Iron-Wire Line Built to Serve Small Communities

Details for the Construction of an Iron-Wire Steel Pole Transmission Line 30 Miles Long, Operated at 22,000 Volts, Together with Material and Labor Costs

BY M. D. LESLIE

Midland Water, Light & Ice Company, Dodge City, Kan.

RELATIVELY inexpensive forms of transmission-line construction have had to be developed lately in the Middle West, as an economic expedient, to serve small communities which are located far from central stations. One line which fulfills operating conditions has recently been built between Dodge City and Bucklin, Kan. The line, which is about 30 miles long, extends in a southeasterly direction, following a road parallel to the Arkansas River and passing through the town of Ford. Bucklin has a population of about 800. Ford has a population of about 300 persons, and had never had electric service. In order to make service available the city built a distribution system which it leased to the company operating the transmission line as soon as the latter was completed. The territory served is not thickly populated, nor are there any other towns of importance within convenient reach of the line. The principal business obtainable is the commercial lighting and power in the two towns, and power for a few grain elevators. The line was designed on the basis of a present peak of 50 kw., with a future capacity of 75 kw. Owing to the length of the line and the small amount of business obtainable, it was necessary that the construction be inexpensive and the upkeep low for the fifteen years of the lease.

The line as constructed operates at 22,000 volts, three-phase, 60-cycle, and consists of three No. 6 EBB galvanized-iron wires mounted horizontally 4 ft. apart on steel arms. Thirty-foot 4-in. Bates expanded steel poles are employed, being set in concrete 300 ft. apart. Every

FIG. 1—RAISING 35-FT. EXPANDED-STEEL POLE

half-mile one pole is head-guyed both ways in the direction of the line. Corner poles and railroad crossings are double-armed, 35-ft. poles being used at crossings.

The general conditions were favorable to the use of iron wire, as the market prices were such as to make the cost of a copper line almost prohibitive, even considering the possibility of using a lower voltage. Since iron wire had been used quite successfully on short lines in other parts of the State, the length of this line was the only factor that caused any misgivings regarding the successful use of iron wire in this case. At the time this line was designed, no information could be located concerning the electrical characteristics of iron wire. EBB wire was chosen on account of its low resistance,

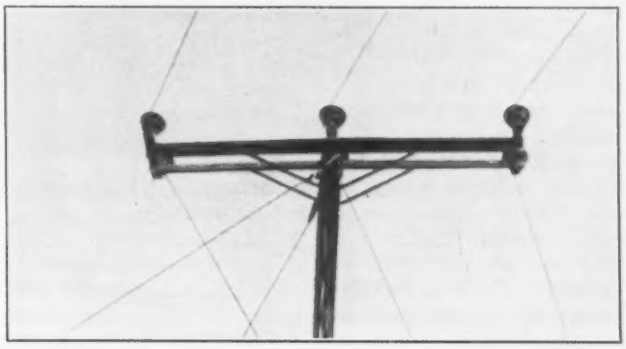


FIG. 2—DOUBLE ARM CONSTRUCTION USED AT CROSSINGS

and the fact that the current would not be more than 3 amp. per phase. The government report on iron wire for transmission purposes (*Bulletin No.* 252) indicated that No. 6 EBB wire would have a lower effective resistance than the other grades for currents up to about 3 amp. Beyond this value the better magnetic properties of the harder wires give them the preference. More recent information indicates that the line loss will be greater than originally estimated, but it will not be sufficient to make any considerable difference for some time to come. In a short time instruments will be available at both ends of the line for conducting adequate tests to determine its characteristics. Curves taken at the end of the line show the voltage excessive at times, but seldom does it drop below normal.

Unexpected difficulties were experienced in calculating the sag, as no tables or curves for this class of work were available. The high modulus of elasticity and low coefficient of expansion of iron makes the use of standard formulas very difficult. This line was designed to withstand a 0.5-in. coating of ice and a 30-mile wind pressure, or a loading of 0.7 lb. per foot. The stress allowed with a maximum sag of 6 ft. at zero deg. Fahr. the temperature of maximum loading, is 75 per cent of the ultimate strength of the wire. Close examination of the problem shows that the unstressed length of the conductor even at 60 deg. Fahr. is less than the span length. No results in the way of a sag curve were obtained until formulas by K. L. Wilkinson, published in the ELECTRICAL WORLD of Feb. 6, 1915, page 336, were located. These permitted a rapid and comparatively simple solution of a difficult problem. The assumptions made for this line were based on the records of the local branch of the U. S. Weather Bureau, which indicate that the loading is more than sufficient. Tests on the wire show it to be somewhat stronger than the values given by the manufacturers.

The original plans for the line called for 30-ft. 7-in. top treated wooden poles set 250 ft. apart, with a triangular arrangement of conductors. After consideration

of life, maintenance and interest charges, steel poles were purchased instead, one of the principal considerations being the destruction of wooden poles by fire and lightning. The steel poles make an attractive line and impress the public with their reliability and permanency. Comparative tests showed that the 4-in. steel poles will fail with a pull of about 1200 lb. at the top, while a 6-in. top 30-ft. wood pole will withstand over 2000 lb. pull without any damage. The wood pole which was tested was one that had been in service for about five years, and had decayed about 1 in. deep from the ground line to the butt. In testing the steel poles, the first was erected in frozen ground and failed by the collapse of the braces below the ground line. The second pole was set in concrete and failed by twisting about 5 ft. above the ground. In the construction of the line, two poles failed. One, which was a double-armed pole, failed to drop to the bottom of the hole when being erected and toppled over, bending the pole edgewise about 8 ft. from the bottom. The second pole was pulled over by a wire joint which caught on the arm while pulling in slack. Without relieving the stress on the wire, one of the linemen climbed to the top of the pole, and his weight, with the tension in the wire, caused the pole to fall to the ground. All of the poles which failed, however, were straightened and reset in the line.

FIG. 3—CLIMBERS USED BY LINEMEN

Experiments were carried on to determine the most satisfactory way of setting the poles in concrete. The manufacturers of the poles supply H-shaped forms, which require about 2 ft. of concrete. The form itself requires a hole about 17 in. in diameter, but the ordinary hole digger cannot be depended upon to center the hole exactly, so it is necessary to dig a much larger hole in order to "line up" the poles properly. It was also found difficult to place concrete in such a small form at the bottom of a hole. Old-fashioned posthole diggers were then tried. Two holes were dug side by side and joined, thus giving a hole about 6 in. by 12 in. in cross-section. This method of construction was satisfactory in some soils, but was abandoned in favor of digging with ordinary tools, which were trimmed down on the sides so that a small rectangular hole could be made. These holes were easily dug, and required from 5 to 6 cu. ft. of concrete to the pole.

Crossarms were distributed with the poles, and a definite quantity of sand left at each pole. The cement was stored along the way, a day's supply being carried by the pole-raising gang. From two to five diggers were employed, according to the nature of the ground. The assemblers were accompanied by a wagon, in which was carried all the necessary material, including insulators.

At the time the line was built is was very difficult to get labor of any kind. Consequently it was necessary to work part of the time with a "short" crew, and to leave the wire stringing for the return trip. A cook shack was maintained for feeding the men and tents provided for them to sleep in. The camp was moved along as the work progressed.

A full raising crew consisted of a driver, two concrete mixers, a "jinney" man, four "pikers" and a foreman. The outfit which was used consisted of one team, a water tank and a sled. The cement was carried on the tank and the sled served to carry the tools from pole to pole and as a mixing box for the concrete. The concrete was usually mixed by the time the pole was set. The poles were raised by ordinary methods, plumbed with a level and tamped in. Poles tamped in with the concrete were stable enough to be left at once. An oval form, 4 in. deep, was made to shape the base above top of the ground. While the majority of the gang moved up along the line to the next pole site, one man stayed behind to trowel off the top of the base and remove the form for use on the next pole. The best day's work by the raising gang was to set thirty-four poles in eleven hours.

The guying and stringing was done on the return trip. Two men dug the slug holes and set the concrete slugs. Two men with a single-horse wagon installed the guys. Four linemen and a teamster did the stringing and tying in. Three coils of wire were distributed every 1/3 mile and picked up by the stringing gang. All three wires were strung at one time from reels mounted on a wagon. The wire was pulled at intervals of about 1 mile, using permanently guyed poles. The usual high-tension tie of No. 8 iron wire was employed on this line.

Five-inch neck-soldered Western Union splices were used, soldering being done with a pot and ladle. Sample splices made by different linemen gave the following results under test:

Sample No.	Maximum Strength (lbs.)	Cause of Failure
1	1850	Splice slipped
2	1870	Wire broke, splice held
3	1810	Wire broke, splice held

The line has been in satisfactory operation for about three months with five interruptions, caused by an insulator being shot off in one case, a wire thrown onto the line in two others, and broken wires, due to defects in the wire itself, in the remaining cases.

The item of engineering given in the accompanying table includes considerable of the writer's time and expenses as well as those of the surveyor. The item of total labor includes all labor of all classes, including the foreman on the job, with the exception of some of the teamsters who were hired at a flat rate per day with their teams and wagons. The item of camp expenses is the net cost after deducting the amount charged the men for meals. Laborers were paid 25 cents per hour

DISTRIBUTION OF TRANSMISSION LINE COSTS
(Distance Dodge City to Bucklin, Kan., approximately 31 miles).

	Total.	Per Mile.
Engineering and survey	$828.50	$26.73
Pole rights	238.30	7.69
Total labor	2,619.59	84.50
Camp expenses and meals	592.54	19.11
Teaming	717.49	23.15
River sand, gravel and cement	356.81	11.51
Insulators	840.03	27.10
Pins	469.30	15.13
Wire (95 miles No. 6 EBB)	3,368.93	108.67
Steel poles (total, 557, including twenty-three guy stubs)	7,856.31	253.43
Guying material	380.31	12.27
Wood poles and line material	287.90	9.28
Transformers, switches and arresters	2,739.63	88.37
Substation material	193.11	6.23
General expense	107.25	3.46
Total	$21,596.00	$696.64

DISTRIBUTION OF LABOR.

Rebuilding of wood-pole line in town to accommodate high-tension line from city limits to plant	$391.30
All work connected with setting 539 steel poles ready for wire	1,133.95
Stringing wire, setting anchors and attaching guys to above poles (about 29 miles of line)	470.64
Building towers and finishing up last mile of steel line	623.30
Total	$2,619.59

and linemen 40 cents per hour, and all were charged 20 cents per meal, which amount covered less than half the cost. The item of teaming includes all expense of teams for hauling various materials and carrying on the work, a charge being made for the use of company teams, as well as those hired.

Labor expenses are distributed in the lower part of the table, so that the actual cost of pole setting is shown. This line, like most others, had special features which made it expensive. One of these was the rebuilding of about 1 mile of wood pole line in order to provide a connection with the power house where the transformers are located. The other condition that affected the installation cost was the finishing up of the last mile on the Bucklin end at a later time with a small crew. This was made necessary by a lack of necessary material, and the expense was entirely out of proportion to the work done. Some of the men on this section of the line also built towers, so it is not possible to give an accurate division of this labor.

The expense given for setting 539 steel line poles and the necessary guy stubs includes all labor connected with such work as digging holes, assembling arms, pins and insulators, setting poles and concreting their bases, as well as the foreman's time and other labor that was paid for.

Formation of Clinkers in Boiler Furnaces

An Analysis of Combustion Conditions in Different Types of Boiler Furnaces and Suggestions to Reduce Clinkering Troubles

BY ALBERT A. CARY
Consulting Engineer, New York City

DURING many years' experience in designing, testing, improving and operating furnaces, used for many purposes, no branch of this subject has been found that requires more consideration than the troublesome formation of clinkers in the furnace and the formation and growth of clinkers on furnace linings. In a great majority of cases this trouble can be either greatly reduced or avoided, for clinkers are formed by the fusion of the ash and refuse which remains after the combustion of the coal in the furnace. Ash is really a very useful material in the furnace, when it is properly taken care of there, since, with a proper thickness of ash covering the top surface of the grate, the burning and warping of the bars is prevented.

Where properly designed shaking bars are used, the thickness of the ash bed on the top surface of the bars can be easily regulated, and it is very necessary that this be properly accomplished with this type of bar, as most of the shaking grates are designed with thin, delicate edges which are easily burned or warped when brought in prolonged contact with a hot fire bed. It is quite essential that the thickness of the ash bed should always be reduced before any attempt is made to break up the fire bed above, otherwise the ash will be thrown up into the bed of fuel and fused into clinker.

The shaking grate improperly used may be productive of more clinker in the furnace than would occur with the plain stationary grate in use. The thickness and conditions of the fire bed have much to do with this grate and clinker trouble, however. The density of the fuel bed is really of more importance than its thickness. A comparatively thin fire bed that is dense and compact will hold the ash within its hot body, instead of allowing it to precipitate to the grate bars, just as much as a thicker bed, when it is more open and porous.

When any fire bed is more or less solid, or compact, the air for its combustion will not pass uniformly throughout its mass, but, on the contrary, this air will search out its easiest paths of passage and flow through the irregularly scattered openings formed by cracks or holes in the fire bed, and, with the ash held up in this densely packed bed, the air, rushing through these selected positions, will cause intense combustion to occur at such places, which rapidly fuses the surrounding ash into clinker and at the same time causes the soft, pasty mass to attach to itself a considerable amount of the solid combustible fuel.

Too thin fires, carried on the grates, should be avoided, especially with shaking grates, as every fire bed should be of sufficient thickness to allow a proper depth of ash to be carried on the bars to protect them from the intense heat of the burning fuel above them. Excepting these very thin fire beds, it may be said that the intensity of draft required to operate a furnace is, generally speaking, a measure of its clinker-making properties, which is another way of saying that the intensity of the draft required is a measure of the density of the fire bed. With a properly constructed hand-fired mechanical grate, the writer has been able to carry a bituminous coal fire continuously (using Eastern bituminous coal) with a fire-bed thickness of from 12 to 18 in., with no troublesome formation of clinkers, and this was done with a coal consumption of between 20 and 30 lb. of fuel per square foot of grate per hour. The whole secret of this performance was due to the fact that the accumulation of ash at the bottom of the bed could be easily kept reduced to a desirable thickness by use of the shaking bars, while the crust or cake forming over the top of the fire bed was broken up, when necessary (as well as the packing of fuel in the interior of the bed), by very slowly moving the lifting part of the grate up into the bed of fuel without disturbing the ash.

This kept the whole fire bed thoroughly broken up and so open and porous that less than 1-in. draft pressure measured by a U tube at the flue outlet (natural, chimney draft) was sufficient to keep the fuel bed (averaging fully 15 in. in thickness) in a highly incandescent state. Under these conditions there was no troublesome formation of clinker that would not go through the shaking bars, and this avoidance of such trouble was emphasized by the fact that no hand cleaning tool was used in the furnace from the beginning to the end of the week. This performance has been repeated in several plants and with a variety of Eastern bituminous coals, with the same non-clinkering results, which proves conclusively that the density of the fire bed has more to do with clinkering trouble than its mere thickness.

CLINKERING IN UNDERFEED STOKERS

The underfeed type of stoker, in its method of working, simply defies all theories for the reduction of clinker troubles. With this type of stoker the coal is fed by plungers or screws, into U-shaped troughs, with the top open surface of these retorts dropped to the upper level of the grate bars. When the troughs (or retorts) are filled, further feeding of coal, by the plungers or screws, will cause the coal to rise above the

SIDE GUIDE & GRIPPER

level of the grate bars, and above this surface is found an incandescent bed of burning fuel into which fire bed the fresh coal from the retort is forced. As the fresh bituminous coal passes upward into the "zone of combustion" its gaseous matter is first liberated by the heat and mixing with the air from the tuyeres (placed at the grate level) it burns as it seeks out its passages of escape through the hot fuel bed above. As fresh coal continues to be forced into the retort below, it shoves the coke above (which remains after the gaseous matter has been driven out of the preceding charge of coal) so that this burning coke becomes the upper incandescent fire bed. This coke continues to be forced upward, burning rapidly until only the ash is left which has been produced in the hot burning mass of coke and forced to the top of the fuel bed.

Very few grades of coal produce ash which will not become fused into more or less of a clinker under such conditions of treatment, and it therefore becomes necessary, where this type of stoker is used, to select a coal which does not run too high in its percentage of ash, and the ash must have the highest fusing temperature possible. By the method of feeding used by this type of stoker, it will be noted that the coal is compactly forced into a more or less condensed mass of burning fuel, which demands the use of heavy forced blast fans, and, in order to reduce the amount of clinkering which occurs, the operator must use every possible means to keep his fuel bed open and porous, otherwise the air for combustion will seek every easy passage for escape, and work its way through cracks and holes in the fuel bed, instead of being more uniformly distributed throughout the mass of hot fuel.

This form of stoker has permitted the feeding of more coal per unit of grate area than its predecessors, and this valuable feature largely offsets its clinkering troubles, as the demand of to-day is for a stoker that will burn coal, and lots of it when required, to carry the plant over its troublesome peak loads.

Side walls with this type of stoker should be kept free from accumulations of ash or clinker at very frequent intervals and before the clinker is allowed to cool and harden to prolong the life of these walls. By a careful selection of the coal and refractory lining for the furnace the worst effects of clinker trouble can be considerably reduced.

Clinkering on Furnace Walls

There is a most troublesome result following the fusion of ash in contact with the side walls and bridge walls of furnaces, which frequently causes expensive repairs and necessitates untimely stoppage in the operation of the boiler, and this occurs in hand-fired furnaces as well as in those equipped with mechanical stokers, although, of course, to a lesser extent.

The selection of refractory material for lining furnaces is a matter which has received altogether too little attention by power-plant owners, who are too often influenced by the most persuasive salesman who calls upon them, or else they leave the matter to their masons, who are in many cases pretty certain to buy the cheapest firebrick or else buy at the place where their commissions are the highest. The common practice of using the same quality of firebrick for all parts of the furnace is certainly a mistake. The side-wall lining of a furnace should be selected with the use to which it is subjected kept in mind. It is true that these side walls are subjected to the effect of high temperatures, but if we use the most refractory bricks we can buy for this position, we will find that they will not stand the severe abrasion to which they are subjected, such as received with the use of the poker, the clinker bar, etc., to free them from the adhering clinker, and it is most important to consider the fluxing effect on these bricks from the ash produced from the particular kind of coal used.

An altogether different kind of service is called for in the refractory arches used over the fire bed, which needs a different quality of brick, and still further consideration should be given in the selection of refractories for use in special-shaped blocks and tiles used in other parts of the furnace. The fire-clay brick is the one used in nearly all boiler settings, and it is probably the best brick adapted to sudden changes of temperatures, due to its more or less porous structure. The fine-ground, hard-burned brick usually gives the best linings for side walls, while the coarser and more open (or porous) bricks are better adapted for fire arches. Accumulation of ash or any incipient formation of clinkers on the side walls or bridge walls of furnace must be promptly removed without allowing them to build up if destruction of the walls is to be avoided.

With the overfeed type of stoker, with inclined grates as has been previously explained, the ash formation out of the fuel does not begin until after the burning coal has descended a certain distance upon the inclined grates. In that class of inclined grate stokers which receive coal at the front end of the furnace and pass the burning fuel slowly downward along sloped grate bars to the rest grate at the rear of the furnace; unless this fuel is constantly being agitated with a shearing motion, next to the side walls, there is a tendency for the ash to fuse and adhere to the side wall at the lower part of the furnace. Convenient poke holes are usually provided through which the fireman can slice the fire next to both side walls and thus reduce the tendency to build up clinker at these positions.

In the other class of inclined grate stokers, which have their fuel fed from coal magazines placed in each side wall, feeding their fuel from these positions down sloped grates to the lower center of the furnace, we find a reduced surface of furnace wall presented to the fire bed, at the rear and front of the furnace. At the bottom of the V, formed where the two sets of inclined grates (from each side wall) come together, there is provided a set of clinker bars which are supposed to remove the ash and clinker automatically as soon as they reach this position, but there is always an accumulation of incandescent ash, clinker and some small amount of fuel at the bottom of this trough, which builds up, especially in the presence of large clinkers formed in the fire bed and where this lower part of the fuel bed comes in contact with the end walls, there is a tendency to build up clinker or erode.

With the chain-grate type of stokers, there is a very slowly moving bed of fuel, each side of which is in contact with the side walls. With a very slow motion of the burning fuel on these grates, there is a tendency, with certain coals, for fusion of the ash to take place, and when this comes in contact with the side walls, due to the slow rate of travel, and clinkering often occurs there. Such trouble is increased when the movement of the grate is stopped for considerable periods of time. Efforts have been made to reduce the destructive action to side walls in furnaces, where this type of stoker was used, by substituting metal faces in the furnace walls to replace the fire-brick lining, back of which faces a water circulation was maintained. Besides the clinker or erosive troubles in stokers of this type, there is added the abrasion caused by the constant rubbing of the fuel bed against the side walls. Notwithstanding the occurrence of such troubles in certain plants using this type of stoker, there are many hundreds in use where fire-brick linings are used in their furnaces, and it is claimed that the cost of repairs for these linings is not excessive, and that it is no higher than in other stokers doing similar service.

Graphical Presentation of Conductor Properties

Description of a Wire Chart, with an Outline of the Method of Using It, Basis for Construction and Method of Plotting Lines

BY ANDRES HAM
Engineer Guadalajara, Jal., Mexico

BY means of the accompanying chart areas, diameters, lengths, resistances and weights of different sizes of copper conductors can be obtained directly, expressed in twenty-two different units. In the writer's opinion, while it is especially useful in Latin American countries, where the metric system is employed, and where considerable business is carried on with companies employing the English system, it will likewise be found most useful by any engineer who has occasion to frequently use wire tables. For instance, if wire is specified in metric terms the corresponding specifications in English terms can be readily determined and vice versa. Furthermore, it permits obtaining any of the previously mentioned properties of a copper wire if one of the properties of the same size copper wire is known. While the chart applies only to copper wire sizes from No. 4/0 to No. 30, the principle used in its construction may be extended to include larger or smaller sizes and other metals, such as aluminum, galvanized iron and steel wire, resistance and fuse wires.

METHOD OF USING CHART (SEE SUPPLEMENT)

To find the area, diameter, length, resistance or weight of any copper wires (size No. 4/0 to 30) in either English units, metric units or combinations thereof, obtain from the "Key to Chart" the number of the line corresponding to the particular units in which the property desired is expressed. From the point where the vertical line through the size of wire intersects the numbered line, follow the horizontal line to the heavy (boldface) or light scale, depending on whether the heavy or light numbered line is intersected. The result is obtained directly. When the property of a conductor is known the size of the wire can be determined by following the reverse operations. Concrete problems are solved on the chart (see Example I).

If it is desired to determine any property of a conductor when another is known, the procedure is as follows: As before, determine the numbers of the lines corresponding to the unit known and the unit desired. Then from the value of the unit known on the vertical scale follow the horizontal line to the numbered line corresponding to the unit known. From this point trace along the vertical line to the other numbered line and opposite the intersection on the lightface or boldface vertical scale, depending on whether the last line is light or heavy, will be found the desired result. The solution of a concrete problem of this type is also given on the chart (see Example II).

BASIS FOR CONSTRUCTION OF CHART

The chart is based on the fact that the diameters and areas of conductors numbered in the B & S or A. W. gage are in geometrical progression. For instance, the area of the larger of two consecutive numbers is $(a\sqrt[3]{2})$, where a is the cross-sectional area of the smaller wire. Thus taking a_o as the area of No. 0 wire and a_n as the area of any other wire (size n) $a_o = a_n(\sqrt[3]{2})^n$, or $a_n = \dfrac{a_o}{(\sqrt[3]{2})^n}$ Since the diameter of wires varies as the square root of the area, then $d_n = \dfrac{d_o}{(\sqrt[6]{2})^n}$.

Taking logarithms of both members of the last two equations,

$$\log a_n = \log a_o - \frac{n}{3} \log \sqrt{2}$$

and

$$\log d_n = \log d_o - \frac{n}{6} \log \sqrt{2}$$

TABLE I—DATA FOR PLOTTING AND EXTENDING WIRE CHART
COPPER WIRE

	Numbers of B. & S. Wire Gage			
	No. 4|0	No. 6	No. 16	No. 40
Diameter—Inches	0.460	....	0.05082	0.00314
Mils	460.	....	50.82	3.145
Millimeters	11.684	....	1.291	0.0799
Area—(Cross sectional)—circ mils	211,600.	....	2,583.	9.888
(Cross sectional)—square mils	166,190.	....	2,029.	7.77
(Cross sectional)—square millimeters	107.22	....	1.309	0.00501
Weight—Pounds per foot	0.6405	....	0.007818	0.00002993
Pounds per 1000 ft	640.5	....	7.818	0.02993
Pounds per mile	3,382.	....	41.28	0.1581
Pounds per meter	2.1	0.2602	0.02561	0.0000982
Pounds per kilometer	2,100.	....	25.61	0.0982
Pounds per ohm 68° F.	13,090.	....	1,950.	0.00002858
Pounds per ohm 122° F.	11,720.	....	1,746.	0.00002559
Pounds per ohm 176° F.	10,570.	....	1,575.	0.00002309
Kilograms per foot	0.2902	....	0.003541	0.00001358
Kilograms per 1000 ft	290.2	....	3.541	0.01358
Kilograms per mile	1,537.00	....	18.70	0.07175
Kilograms per meter	0.953	....	0.01161	0.0000445
Kilograms per kilometer	953.	....	11.61	0.0445
Kilograms per ohm. 68° F	5,939.	....	885.	0.00001296
Kilograms per ohm. 122° F	5,317.00	....	792.	0.00001160
Kilograms per ohm. 176° F	4,794.	....	715.	0.00001046
Length—Feet per pound	1.561	....	127.9	33,410.
Feet per kilogram	3.444	....	282.	73,700.
Feet per cwt. of 100 lb.	156.1	....	12,790.	.....
Feet per cwt. (of 112 lb.)	174.9	....	14,330.	.....
Feet per ton of 2000 lb.	3,122.	....	255,800.	.....
Feet per ton (of 2240 lb.)	3,500.	....	286,400.	.....
Feet per metric ton (1000 kg.)	3,444.	....	282,700.	.....
Feet per ohm 68° F.	20,440.	....	249.4	0.955
Feet per ohm 122° F.	18,290.	....	223.3	0.8548
Feet per ohm 176° F.	16,510.	....	201.5	0.7713
Meters per pound	0.4764	....	39.0	10,200.
Meters per kilogram	1.050	3.837	86.	22,520.
Meters per cwt. (of 100 lb.)	47.64	....	3,900.	.....
Meters per cwt. (of 112 lb.)	53.4	....	4,370.	.....
Meters per ton of 2000 lb.	952.8	....	78,000.	.....
Meters per (of 2240 lb.)	1,067.	....	87,300.	.....
Meters per metric ton (1000 kg.)	1,050.	....	86,000.	.....
Meters per ohm 68° F.	6,240.	....	76.1	0.2912
Meters per ohm 122° F.	5,580.	....	68.2	0.2607
Meters per ohm 176° F.	5,040.00	....	61.5	0.2352
Resistance—Ohms per foot 68° F.	0.00004893	....	0.004009	1.047
Ohms per foot 122° F.	0.00005467	....	0.004479	1.170
Ohms per foot 176° F.	0.00006058	....	0.004964	1.296
Ohms per meter 68° F.	0.0001604	....	0.01314	3.432
Ohms per meter 122° F.	0.0001792	....	0.01468	3.840
Ohms per meter 176° F.	0.0001985	....	0.01628	4.252
Ohms per mile 68° F.	0.2583	2.081	21.168	5,530.
Ohms per pound 68° F.	0.00007639	....	0.5128	34,980.
Ohms per kilo 68° F.	0.0001684	....	1.130	77,100.
Breaking stress hard drawn pounds	8,310.00	....	133.	.....
Annealed pounds	5,650.	....	69.	.....
Hard drawn kilograms	3,770.00	....	60.3	.....
Annealed kilograms	2,561.00	....	31.3	.....

The logs of a_0, d_0 and $\sqrt{2}$ are constants, however, so log a_n is proportional to $n/3$ and log d_n is proportional to $n/6$.

Thus if a_n or d_n are plotted on logarithmic scales they will be directly proportional to the size of the wire in B & S or A. W. gage, and can therefore be plotted as straight lines. As shown by the equations of the lines, the slope of the lines showing variation in area will be twice that of those showing the variation in diameter with size of wire. Since all properties to which this chart applies are proportional to the diameter, area or powers thereof, they, too, can be plotted as straight lines, their slopes depending on the ratio of the quantity to the diameter or area.

As values from 0.00001 up to 100,000 have to be plotted on this chart, this range of values is split in half and 0.00001 to 1 plotted on the right-hand scale and 1 to 100,000 on the left-hand scale. This arrangement reduces the size of the chart and permits reading all values to the same degree of accuracy.

TABLE II—DATA FOR ALUMINUM AND NICHROME WIRE SIMILAR TO THAT IN TABLE I

ALUMINUM WIRE	No. 4/0	No. 6	No. 16	No. 40
Resistance—Ohms per 1000 ft.	.0790	0.637	6.475	1,691.1
Ohms per mile	.4173	3.36	34.19	8,930.
Ohms per kilometer	.2594	2.089	21.22	5,550.
Ohms per lb.	.00041	0.0266	2.7505	18,770.
Length—Feet per ohm	12,652.	....	154.4	0.59
Feet per pound	5.13	....	420.8	.....
Feet per kilogram	11.30	....	928.	.....
Meters per kilogram	3.45	....	238.	.....
Meters per ohm	3,865.	....	47.1	0.18
Meters per pound	1.562	....	128.4	.....
Miles per ohm	2.398	0.2992	0.02945	.....
Weight—Pounds per 1000 ft.	195.	....	2.375	.....
Pounds per mile	1,029.	....	12.55	.....
Pounds per kilometer	640.	....	7.79	.....
Kilograms per 1000 ft.	88.45	....	1.077	.....
Kilograms per mile	466.5	....	5.69	.....
Kilograms per kilometer	290.	....	3.53	.....
NICHROME WIRE				
Resistance—Ohms per 1000 ft. 68° F.	2.81	....	230.	66,700.
Ohms per meter	0.00922	....	0.7545	218.7
Ohms per 1000 ft. 1000° F.	3.48	....	286.	82,800.
Ohms per meter 1000° F.	0.0116	....	0.937	271.
Ohms per pound	0.00471	0.3001	31.	2,333,000.
Ohms per kilogram	0.1038	0.662	68.4	5,145,000.
Weight—Pounds per 1000 ft.	583.	....	7.2	0.025
Pounds per ohm	212.3	3.3334	.0323	.....
Kilograms per ohm	96.3	1.510	.01462	.....

TABLE III—DATA FOR GALVANIZED IRON AND STEEL WIRE IN DIFFERENT UNITS

GALVANIZED IRON & STEEL WIRE	No. 4/0	No. 6	No. 16	No. 40
Weight—Pounds per 1000 ft.	556.	....	6.78	.....
Pounds per mile	2,937.	....	25.50	.....
Pounds per kilometer	1,822.	....	22.22	.....
Kilograms per 1000 ft.	252.	....	3.07	.....
Kilograms per mile	1,333.	....	11.56	.....
Kilograms per kilometer	827.	....	10.07	.....
Resistance—Ohms per mile "EBB"	1.603	....	131.	.....
Ohms per mile "BB"	1.87	....	153.1	.....
Ohms per mile, steel	2.215	....	181.2	.....
Ohms per 1000 ft. "EBB"	0.3034	2.44	24.80	.....
Ohms per 1000 ft. "BB"	0.3543	2.85	29.00	.....
Ohms per 1000 ft. steel	0.4194	3.38	34.35	.....
Ohms per kilometer "EBB"	0.998	8.00	81.50	.....
Ohms per kilometer "BB"	1.163	....	95.20	.....
Ohms per kilometer, steel	1.378	....	112.80	.....
Breaking stress iron pound	8,820.	....	106.50	.....
Steel, pound	16,600.	....	203.50	.....
Iron kilograms	4,000.	....	48.30	.....
Steel kilograms	7,525.	....	92.30	.....

TABLE IV—RESISTANCE OF DIFFERENT METALS AT 68° F. (20° C.)

	No. 0000 B. & S. Ohms per		No. 16 B. & S. Ohms per		No. 40 B. & S. Ohms per		Relative Resistance (Copper =1)	Per Cent Increase of R. for 1° C. at 20° C.
	Km.	1000 Ft.	Km.	1000 Ft.	Km.	1000 Ft.		
Copper annealed	0.1603	0.0489	13.14	4.009	3,430	1,047	1.000	0.388
Copper hard drawn	0.1640	0.0500	13.45	4.099	3,510	1,070	1.022	0.388
Silver annealed	0.1476	0.0450	12.08	3.688	3,160	964	.920	0 377
Silver hard drawn	0.1605	0.0490	13.15	4.012	3,435	1,048	1.001	0.377
Gold annealed	0.2105	0.0642	17.27	5.262	4,510	1,373	1.312	0.365
Gold hard drawn	0.2143	0.0654	17.58	5.360	4,685	1,398	1.337	0.365
Aluminum annealed	0.2930	0.08945	21.23	6.475	5,550	1,691	1.828	0.365
Zinc pressed	0.5665	0.1727	46.41	14.15	12,130	3,700	3.530	0.365
Platinum annealed	0.911	0.2778	74.65	22.76	19,500	5,950	5.682	0.365
Nickel annealed	1.254	0.3827	102.70	31.32	26,800	8,180	7.82	0.365
Tin pressed	1.332	0.4062	109.20	33.27	28,500	8,690	8.31	0.365
Lead pressed	1.940	0.5920	159.0	48.53	41,500	12,670	12.09	0.387
Antimony pressed	3.590	1.094	294.0	89.70	76,700	23,400	22.37	0.389
Bismuth	13.18	4.020	1079.5	329.2	282,200	86,050	82.2	0.354
Mercury column	8.97	2.733	734.0	223.8	191,800	58,500	55.9	0 072
2 Ag+1 Pt	2.30	0.702	188.5	57.5	49,300	15,020	14.35	0.031
"German silver"	1.982	0.6045	162.2	49.52	42,400	12,920	12.36	0.044
2 Au+1 Ag	1.033	0.315	77.7	23.70	20,300	6,194	6.447	0.065

METHOD OF PLOTTING LINES

Since, as previously explained, all properties of wires expressed in terms of area, diameter, lengths, resistance or weight are straight-line functions when plotted on this chart, it is only necessary to know two points on each line to draw them. For convenience, the properties of No. 4/0, No. 6, No. 16 or No. 40 are used, as many of the functions have to be represented by two separate lines, each of which requires two points for location. These values are given in the accompanying table. If it is desired to represent properties that are not indicated on the chart, it is only necessary to plot the values given and connect corresponding values by straight lines.

Vacuous Arc Lamp

An arc lamp operating in a vacuum chamber in which the electrodes are fixed and non-disintegrating constitutes patent No. 1,208,597 issued to George M. J. Mackay of Schenectady, N. Y. The essential condition of operation appears to be that one electrode be incandescent and for this reason two conductors are led into the top of the envelope, whereas only one lead is provided for the anode. The device comprises an envelope consisting of glass, such as low expansion or sodium-magnesium boro-silicate glass. The cathode consists of highly refractory material having a melting point exceeding at least about 2000 deg. C., such, for example, as tungsten, tantalum, carbon or the like. The anode consists of conductive material, for example, tungsten, carbon or other solids, but in some cases a liquid such as mercury may be used.

The globe is first evacuated and then filled with a suitable gas at considerable pressure. Monatomic gases of the argon group, also nitrogen, and carbon monoxide, may be used. The gaseous pressure will more usually approach atmospheric pressure in order of magnitude. In a device used for rectifying alternating current at low voltages, argon at a pressure of about 5 to 12 c.m. of mercury is found suitable. With an envelope containing a filling of nitrogen, phosphorous pentoxide is preferred for absorbing water vapor and other gaseous impurities. In devices filled with a monatomic gas, such as argon, neon, krypton, xenon, or helium, calcium magnesium or one of the related metals is preferable. By the use of a gas-absorbing chemical agent, the potential drop or loss is reduced to one-half, or even less.

To give specific illustrations, an incandescent cathode arc carrying about 6 amp. when filled with argon purified by ordinary methods has an arc drop of about 30 to 40 volts. When the envelope contains a small quantity of phosphorous pentoxide, as above described, the arc drop is reduced to about 10 volts. Similarly a 6-amp. neon tube containing, at a pressure of about half an atmosphere, neon gas purified by the usual methods, has an arc drop of about 50 volts. The same tube when provided with metallic calcium acting to purify the gas *in situ* in the manner above described has an arc drop of about 20 volts.

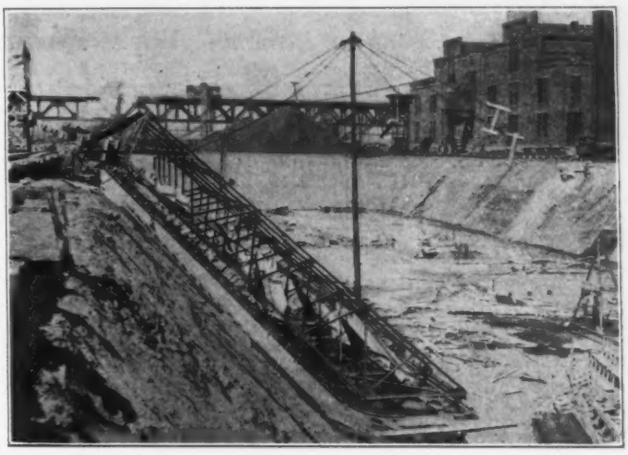
UNDER-WATER COAL STORAGE

Provisions Made by the Duquesne Light Company for Submerging 100,000 Tons of Coal

To prevent spontaneous combustion in the large amounts of coal that must be kept on hand for consumption in the Brunots Island generating station, the Duquesne Light Company, Pittsburgh, is just completing a huge concrete basin in which 100,000 tons of coal may be submerged in water. While it has been realized for some time that spontaneous fires are liable to start in coal piled to a greater depth than 15 or 20 ft., the building of this reservoir was really prompted by the loss sustained over a year ago when hundreds of tons of coal were destroyed before the smoldering fire could be extinguished.

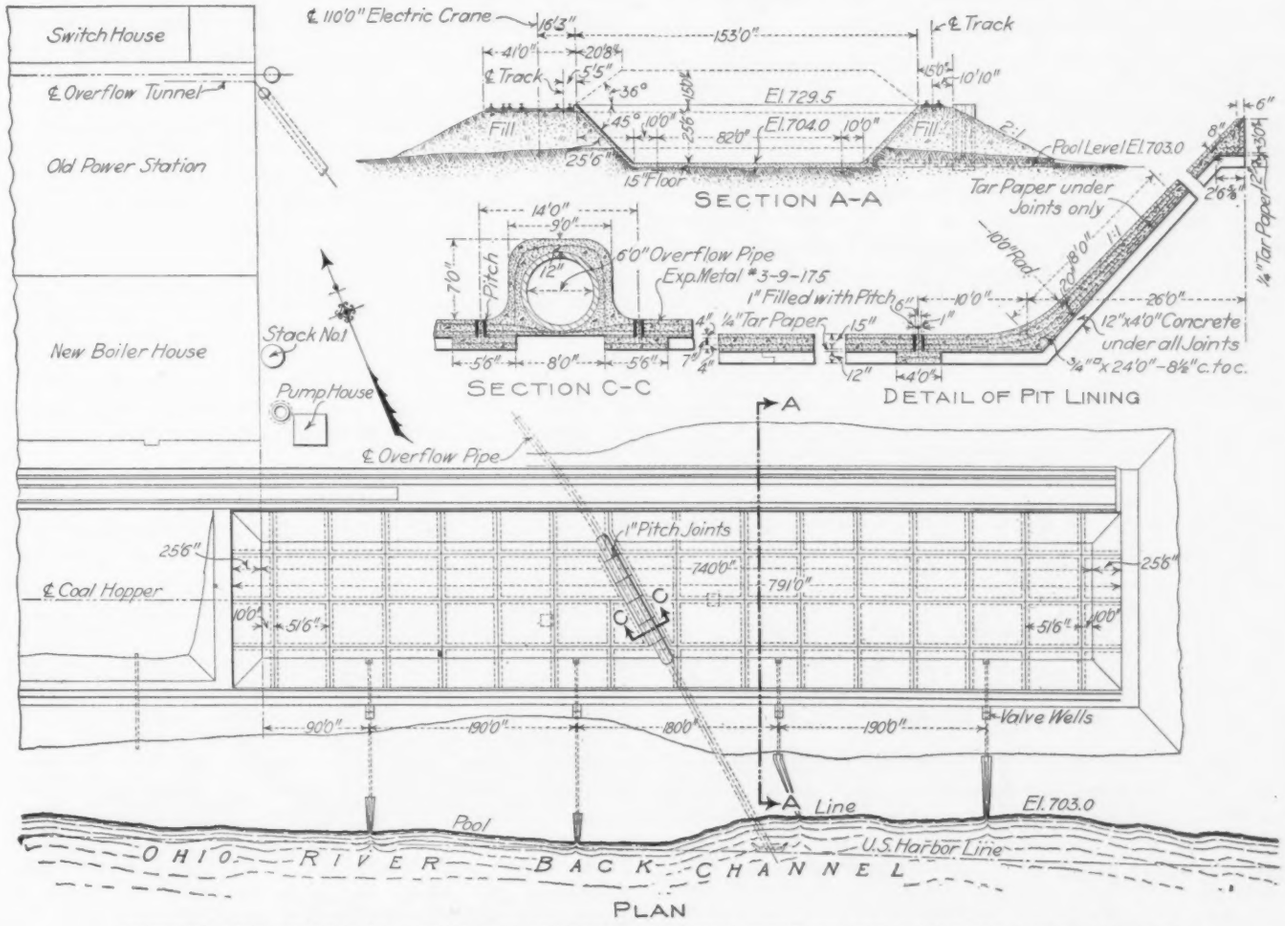
The basin is about 25.5 ft. deep by 791 ft. long by 153 ft. wide, and is made of 40 by 50-ft. reinforced concrete slabs laid so as to permit expansion and contraction. The inside walls have a 1:1 slope, while the outside embankments have a 2:1 incline. A rip-rap wall of double stone is provided over this embankment to prevent erosion during high water. Cranes will be provided for handling the coal. Since the basin has so much displacement automatic valves have been provided to flood the reservoir in case of high water so it will not float. This was done by equipping the discharge system with check valves which permit water to rise inside the pit as the river elevation rises during flood season. The discharge system which consists of four 18-in. pipe lines are located as shown in the accompanying diagram. Across the bottom and sides of the pit every 51.5 ft. longitudinally and lengthwise of the bottom 41 ft. apart are expansion joints. These are made waterproof with pitch and tar paper and are supported on 12-in. concrete bases.

Water for submerging the coal is pumped into the reservoir through a 14-in. cast-iron pipe leading from the power house to four 12-in. cast-iron outlet pipes placed 160 ft. apart in plan and about 6 ft. below the top of the reservoir. The 6-ft. concrete overflow pipe shown on the plan is not connected in any way with the water system of the coal storage tank, but was already in place when the construction of the reservoir was started. The special covering shown had to be provided to protect it from mechanical injury.



INTERIOR VIEW OF STORAGE PIT DURING CONSTRUCTION

The pit is being constructed by the Duquesne Contracting Company of Pittsburgh. The design was made and the construction was supervised by F. Uhlenhaut, Jr., chief engineer of the Duquesne Light Company, Pittsburgh, Pa.



CONSTRUCTION DETAILS OF A COAL-STORAGE RESERVOIR BEING BUILT BY THE DUQUESNE LIGHT COMPANY

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

How Ice on Transmission Line Was Held to Safe Limits During Sleet Storm

BY STUART VAN BUREN

During a recent severe sleet storm the writer successfully prevented ice forming in dangerous quantities on the conductors of a transmission line by using the heating effect of the current. This line is of double-circuit construction connecting a large power house with a substation 50 miles away. Under normal conditions the two circuits were operated in parallel at 60,000 volts. As the storm occurred during light load operation, the line current was not sufficient to produce the desired heating effect. It was therefore decided to use wattless current.

In order to do this the two lines were first separated at the power house with one generator on each line, but were left in parallel at the substation end. Next, the field excitation was raised to the limit on one machine and was lowered as much as possible on the other. This set up a heavy wattless current between machines which was forced to flow over the transmission lines through the substation loop. This scheme proved effective in keeping the ice on wires within safe limits.

Auxiliary Oil Burners for Carrying Emergency Loads

Four auxiliary oil burners have been provided for each of the boilers installed at the Dutch Point station of the Hartford Electric Light Company to carry unexpected peaks such as might occur if any boilers or coal-handling apparatus become incapacitated. As shown by the accompanying drawings the burners are installed on the side walls of the furnaces in such a manner that they may be inserted in rectangular openings and the flames directed across the furnace. Being connected with the oil and steam supply lines by swivel joints the burners can be folded up against the furnace wall when not in use and the wall openings closed by doors hinged along the top. The openings are about 4.5 ft. above the floor level and 3 ft. apart, the one nearest the stoker being 30 in. from the front wall. Sufficient space is provided around each burner to admit the air required for combustion.

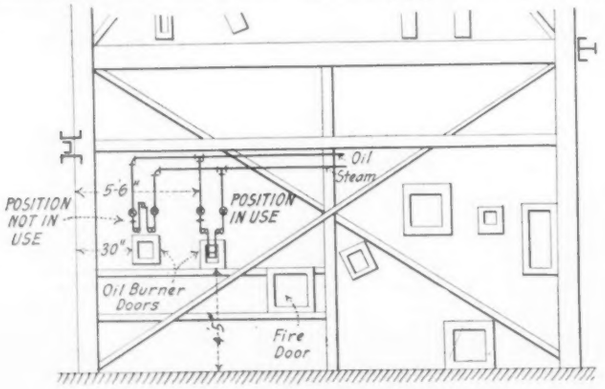


FIG. 1—POSITION OF BURNERS ON BOILERS

The oil and steam supply pipes approach the openings vertically and terminate in swivel joints about 14 in. above the center lines of the furnace-wall openings. At these joints they are connected with pipes that hold the burner-nozzle tip almost even with the inside wall of the furnace when in position for operation. The pipes are bent and connected in such a manner that the nozzle and pipes connecting with it may turn about an axis through the two swivel joints. Globe valves are provided in both pipes leading to the burner, but the oil flow is regulated by an additional valve installed below the globe valve. Since no auxiliary equipment, such as baffles to protect the grates, is required with the equipment, it does not hinder normal operation when the underfeed stokers are used. In one case a brick checker work was built over the grate, however, to ascertain its effect on oil-burner operation. With this temporary addition the oil burners were able to carry 200 per cent of boiler rating according to F. M. Wilbraham, a superintendent of the Hartford company.

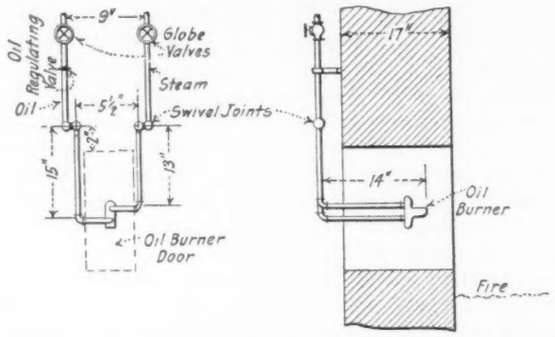


FIG. 2—NOZZLE CONNECTIONS TO STEAM AND OIL PIPES

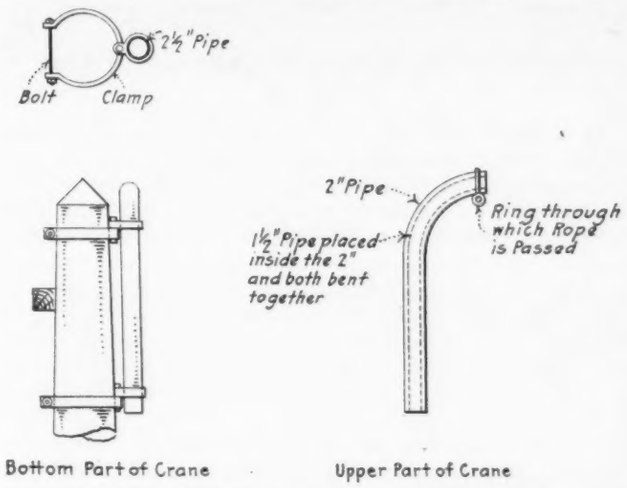
The boilers installed at this plant are 1250-hp. Bigelow-Hornsby units. Three are equipped with Riley underfeed stokers and the remainder with Taylor stokers. W. N. Best oil burners are used in the installation described.

Construction of a Convenient Pole-Top Crane

A convenient pole-top crane constructed as shown in the accompanying illustration has been devised by Mr. Henry Manztel, superintendent of Overhead Construction, Galveston (Tex.) Electric Company. It consists of two pieces of pipe and two adjustable clamps to hold it on the pole. The upper part of the crane consists of a 1.5-in. pipe placed inside of a 2-in. pipe, and both curved together. The diameter of the upper clamp is from 7 in. to 9 in. and the lower clamp 8 in. to 10 in. The pipe fitted to the clamps is 2.5 in. in diameter.

To use this device, the lineman hoists up the section of 2.5 in. pipe to which the two adjustable clamps are fitted. Since the bolt in the lower clamp may be swung free, the upper clamp is slipped over the pole top, the lower clamp bolt swung into place and the two bolts tightened up. When the upper section of the crane is dropped inside the first section the crane is ready.

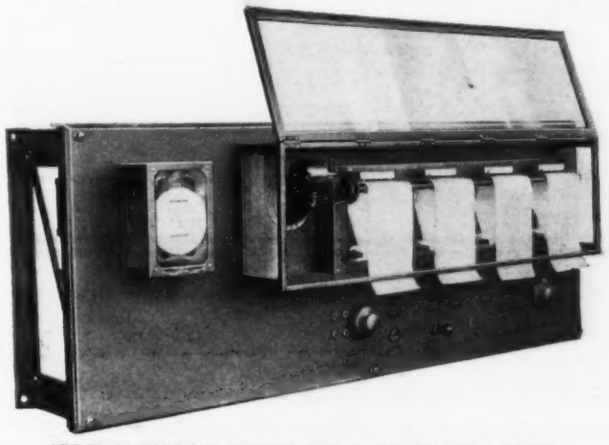
This crane has been found especially useful where a transformer must be removed from a defective crossarm and a new crossarm installed. In such a case a rope is passed through the ring of the crane and fastened to the transformer, which is then swung free. Since the lineman can rotate the upper part of the crane through any angle, the transformer may be easily swung out of the way, around to the other side of the pole, a new crossarm put up, and the transformer put back in place. The crane may be made whatever length desired. The one described has an over-all length when set up of about 5.5 ft., the bottom portion being about 3 ft. long. This device was made in the shops of the Galveston Electric Company, at a total cost for time and material of about $12.



TOP AND BOTTOM SECTIONS OF POLE-TOP CRANE

Testing Unit for Investigating the Operation of an Electric Shovel

An outfit consisting of four graphic recording meters and an integrating wattmeter, all connected on a slate panel has been recently developed by the Chile (S. A.) Exploration Company to investigate the operation of an electric shovel at its copper mines. This testing outfit is provided with necessary transformers, wiring, and jacks to enable any test to be made rapidly and without changing connections. The graphic meter equipment consists of a polyphase wattmeter, single-phase ammeter, voltmeter and a speed recorder. The arrangement of jacks as shown under the meters in the accompanying illustration, enables the operator to connect any one of the graphic meters with either the hoisting, thrust or turning motor, or if it is desired the wattmeter and the ammeter can be connected to record the total load being taken by the shovel. The speed recorder is arranged for connection to either of the three motors. The charts of the graphic meters are all coupled to run together at any speed from 3 in. to 9 in. per minute; the speed of the chart being varied according to the conditions of the test. The chart is driven by a small motor which can be seen at one end of the drive roll. The watt-hour meter is connected permanently to measure the total load taken by the shovel. This outfit has been made for the Chile Exploration Company by the Esterline Company of Indianapolis, Ind.



SPECIAL TESTING OUTFIT FOR AN ELECTRIC SHOVEL

Impressing Employees with the Value of Supplies to Prevent Waste

By handling small articles like repair parts, insulators, brushes, tape, etc., day after day employees are very liable to forget their aggregate value and be careless with them. Since a considerable part of the total expense of a production and transmission department is made up of just such items, however, it is important that companies take steps to prevent any waste due to this cause.

One method that has been employed by the Consumers Power Company, Jackson, Mich., has been to print cards impressing employees with the value of supplies that pass through their hands. On these cars the following information is printed:

MATERIAL MEANS MONEY

Every Piece of Material Should Earn Its Cost, just as Should Every Hour of Labor. Did you Ever See Any Material Wasted? Did You Ever Waste Any Material Yourself?

DID YOU EVER STOP TO THINK OF ITS COST?

For your own information consult this list and see if you have ever been guilty of throwing away or

ABANDONING DOLLARS

Anchors and rods	$1.00	each
Batteries (dry cells)	.30	each
Bolts, machine, ⅜x4½	8.40	per M.
Brooms	.40	each
Brushes, 2½x1¼x¾	.43¾	each
Brushes, 2¼x1¼x1½	.34	each
Brushes, metite	1.69	each
Crossarms, 8 inch	.60	each
Crossarms, 5 inch	.40	each
Electrolyte KD	.75	per gal
Fire extinguisher (container)	6.50	
Fire extinguisher (Pyrene)	4.00	per gal.
Gasoline	.10	per gal.
Grease (transmission)	.50	per lb.
Hose, garden, ¾ inch	.18	per ft
Insulating compound (G. E. 178)	.75	per gal.
Insulators, 17,000 V	.19	each
Insulators, 40,000 V	90	each
Insulators, 70,000 V	2.00	each
Insulators, suspension type	.85	each
Lamps, 25-watt Mazda	.27	each
Lamps, 40-watt Mazda	.27	each
Lamps, 50-watt Mazda	.36	each
Lamps, 100-watt Mazda	.65	each
Motor bearings, 5 hp	2.08	per set
Motor bearings, 15 hp	4.50	per set
Oil—engine	.22	per gal.
Oil—cylinder	.48	per gal.
Oil—transil	.30	per gal.
Paint (floor enamel)	2.00	per gal.
Packing	.90	per lb.
Rectifier tubes	25.00	each
Relay contacts (Terrill Reg.)	2.75	per set
Rings—A. C. Collec. 900 r.p.m.	50.00	per set
Rings—A. C. Collec. 1200 r.p.m.	40.00	per set
Screws, ½x5 in. lag	.0157	each
Solder—wire	.30	per lb.
Solder—bar	.30	per lb.
Soldering paste	.10	box
Switch bars—K-12 oil	3.75	each
Switch fingers—K-12 oil	.30	each
Tape (friction) 2 rolls to pound	.35	lb.
Waste (white)	.08	lb.
Waste (wiping rags)	.16½	lb.
Wire, No. 10 B. & S. R. C.	.043	per ft.
Wire, No. 12 B. & S. R. C.	.034	per ft.
Wire, No. 14 B. & S. R. C.	.027	per ft.
Wire, Band, .072 Steel	1.50	per lb.
Wire, 1/4-in., stranded (5000)	.0157	each
Scrap copper	.16	lb.

AN EFFECTIVE CARD IN ACQUAINTING EMPLOYEES WITH VALUE OF MATERIAL USED

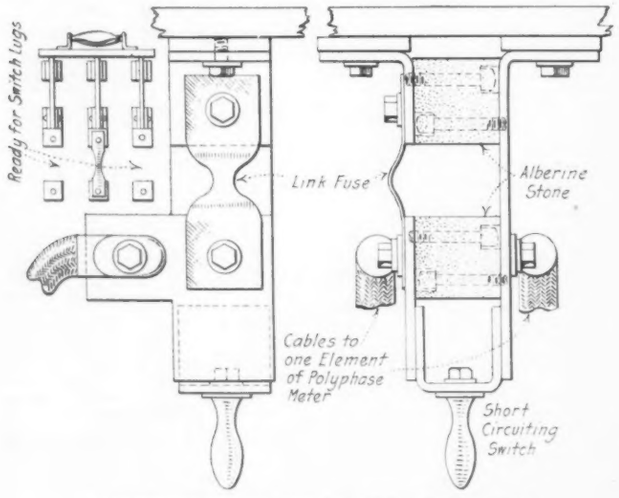
W. J. McCullough, general storekeeper of the Southern California Edison Company, has also expressed the opinion that the ease with which an employee is able to obtain material has a great deal to do with the value of the material in his mind. For this reason it is necessary that the workmen should be required to exert some effort before letting them have the material wanted. In other words, if a workman can come up to the counter and call for a coil of copper wire, a dozen connectors, etc., whenever he chooses, he is not so impressed with the value of the material as when he is obliged to go to the foreman and get a regular order and sign a receipt for the material before taking it from the store. Providing stock material will answer the purpose, it should be used rather than to leave it on the shelves and buy new, even at a lower figure, for the reason that in many cases surplus stock would in this way be eliminated. On the other hand, if a purchase is made, the old stock is not disposed of and additional money is invested.

Proper care of material does not necessarily require elaborate storerooms. It does mean, however, that rubber goods, rubber insulating materials, etc., should be kept in moist rooms; that pipes, conduits, etc., which must sometimes be stored outside, should be kept painted, threaded ends should be greased, or similarly protected to avoid rust; that lumber, poles, crossarms, etc., should be kept off from the ground on skids to avoid rot; that material moving slowly should be so reported; that the man in charge should know the location of and be able to produce any material in his charge immediately when called upon for it, so that it will be ready for use.

Arrangement for Studying Loads Without Breaking Circuit

BY SIDNEY FISHER

When load variations in different circuits have to be determined with one set of apparatus and little time is afforded between tests for changing apparatus connections, detachable switch lugs like the one shown herewith may be found serviceable. This particular design was developed for use in a large Connecticut industrial

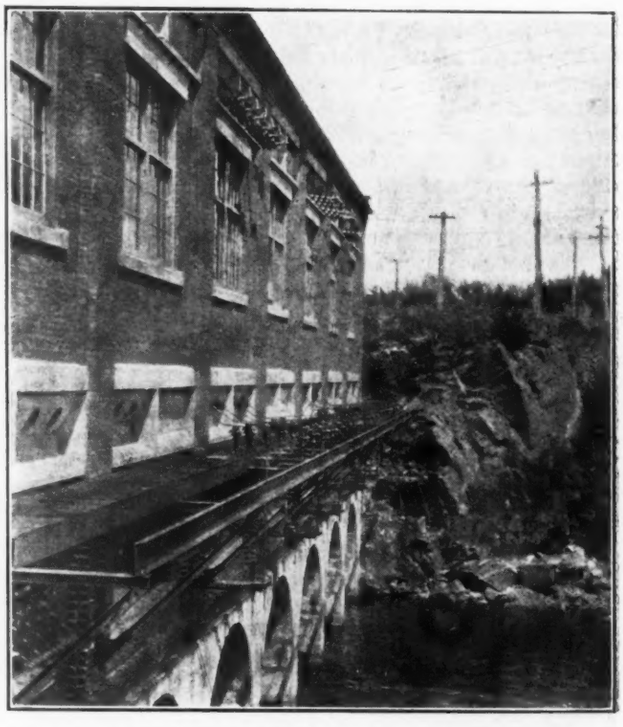


CONSTRUCTION OF DETACHABLE SWITCH LUG

plant where load tests had to be made in different circuits during three successive shifts. Only twenty minutes was allowed for changing connections from one circuit to another. As shown each device is constructed so that it may be bolted to the fuse lugs of any branch-circuit switch in place of the fuses. To permit leaving each circuit intact while adjusting the instrument and transformer connections a short-circuiting switch was provided in the head of each detachable lug. If time permits, the fuses that are removed to give place to the lugs may be attached to the latter, but considerable time is saved by having each detachable lug equipped with fuses in advance. Provision is made for link fuses.

One Way of Solving a Difficult Wiring Problem

In a New England plant supplying numerous factories with hydroelectric service the handling of the outgoing circuits was rendered unusually difficult on account of the location of the building across a narrow gorge and directly over a river. The interior arrangement of the station necessitated carrying the outgoing lines out from the down-stream side above the tail-race. The main difficulty was the location of the lightning arrester connections and horn-gaps. The problem was solved by erecting a structural steel platform along the entire length of the station, providing a wooden walkway on the dead side of the arrester leads and mounting the horn-gaps over an opening between the walkway and an outside channel iron which ties the bracing together. Through this opening the rods governing the rotation of the horn-gaps are carried vertically to the bottom of the frame and then connected with the station interior by horizontal runs. The live lines are dead-ended on strain insulators in the usual fashion at the top of the station wall, taps being carried through bushings from the high-tension buses to the outgoing lines. Other bushings in concrete panels lower down provide space for the entering arrester leads, the outer halves of the horn-gaps being reached by diagonal taps from the main lines above. This arrangement makes the wiring accessible at the horn-gaps without carrying the latter into the building, and while not to be recommended as a promenade, furnishes a means of access when necessary far superior to the usual temporary staging or boatswain's chair.



LIGHTNING ARRESTER CONNECTIONS AND HORN-GAPS INSTALLED ON STEEL PLATFORM ON SIDE OF STATION

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

University Building Flood-Lighted as Demonstration for Students

During the meeting of the Indiana Engineering Society at Purdue University, Jan. 18 to 20, Eliza Fowler Hall, one of the university buildings, was flood-lighted to demonstrate the possibilities of flood-lighting to the convention delegates and to the engineering undergraduates at the school. To light the building, the front of which measured 100 ft. by 125 ft., two batteries of projectors, each containing five 1000-watt lamps, were placed in front and somewhat to the sides of the building at a distance of 125 ft. from its corners. The accompanying illustration shows the building as it appeared under the illumination. The lighting units were furnished by the American Lighting Company.

ELIZA FOWLER HALL AT PURDUE UNIVERSITY REFLECTING 5-KW. OF LIGHT

FIFTY RANGES IN TOWN OF 3500

The Experiences of the Municipal Plant at Lake City, Minn., in Selling and Serving Electric Ranges

Lake City, Minn., which has a population of 3500, owns its electric light plant, purchasing energy from the Wisconsin-Minnesota Light & Power Company. The local plant has just passed through its first season's experience at selling electric ranges. The electrical affairs of the city are handled by a board of water and light commissioners, of which J. Cole Doughty is chairman. In the following Mr. Doughty tells how fifty ranges were sold at Lake City:

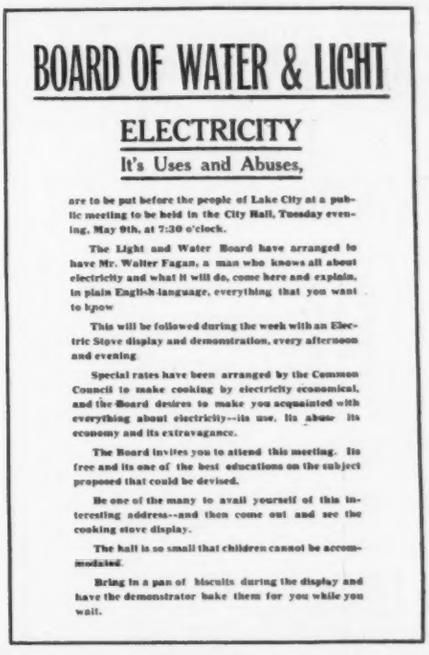
"First we applied to several different electric range manufacturers in an endeavor to get them together for a joint exhibition of their wares. We were not successful in this, as we found they insisted on the whole field or none. We finally secured the co-operation of the present company. We then fitted up the auditorium of our city hall for an exhibition room. We advertised in the local papers that an exhibition of electrical cooking would be given at the hall, extending through four days, covering Wednesday, Thursday, Friday and Saturday.

"The manufacturer sent his demonstrators and they gave a talk to our citizens in general assembly on the use of electricity as applied to cooking and heating. Assisted by a member of the board, they also took orders from persons desiring the appliances. In addition, they made demonstrations in cooking every day, showing what could be accomplished. They brought with them a young lady who thoroughly understood her business, and who was not only a good cook, but was also a good canvasser. They put in the week here canvassing every prospect.

"In the meantime we had prepared circulars which we distributed very freely among the users of electricity. These attracted considerable attention and brought inquiries that enabled us to reach many people whom we probably should not have reached in any other way.

"A member of the water and light commission was in attendance at each meeting taking orders and assisting in a general way. This we regard as having added considerably to our success, as it gave the project the indorsement and backing of our board. Our room was equipped with hot plates, ranges, cabinet ranges, electrical washing machines, sad irons, electric fans, and such appliances as would naturally come into play under our special rate.

"In addition to this we made a summer rate of 2.5 cents per kilowatt (to be used with a separate meter) and to extend from the April 20 reading to and including the November reading. The rate for the winter



BOARD OF WATER & LIGHT

ELECTRICITY

It's Uses and Abuses,

are to be put before the people of Lake City at a public meeting to be held in the City Hall, Tuesday evening, May 9th, at 7:30 o'clock.

The Light and Water Board have arranged to have Mr. Walter Fagan, a man who knows all about electricity and what it will do, come here and explain, in plain English language, everything that you want to know

This will be followed during the week with an Electric Stove display and demonstration, every afternoon and evening

Special rates have been arranged by the Common Council to make cooking by electricity economical, and the Board desires to make you acquainted with everything about electricity--its use, its abuse its economy and its extravagance.

The Board invites you to attend this meeting. Its free and its one of the best educations on the subject proposed that could be devised.

Be one of the many to avail yourself of this interesting address--and then come out and see the cooking stove display.

The hall is so small that children cannot be accommodated.

Bring in a pan of biscuits during the display and have the demonstrator bake them for you while you wait.

"BRING IN A PAN OF BISCUITS AND HAVE THE DEMONSTRATOR BAKE THEM FOR YOU WHILE YOU WAIT," WAS THE FRIENDLY INVITATION FEATURED IN THIS NEWSPAPER ADVERTISEMENT BY THE LAKE CITY LIGHTING BOARD

service was established at 3.5 cents, all conditioned upon a measurement of electrical current through the separate meter. We found, however, that the great 'bug-a-boo' we had constantly to contend with was the matter of installation. Consequently, we took this feature in our own hands, installing the stoves ready for operation at the list price. This enabled us to make a definite price to start with, so that people knew exactly what their investment would amount to. The customers own their meters. The stoves are guaranteed as to the 'elements' for a period of one year. Contrary to our expectations, all ranges averaged a greater price than we anticipated.

"As is usual among people starting something new, we made some errors, among which was placing our cooking rate too low. We should have demanded 3 cents per kilowatt during the summer months and 4 cents as a winter rate. With that change this would have been very desirable business.

"We anticipate a considerable dropping off in the use of electrical ranges during the winter months owing to the fact that, in this climate, so many residences are equipped with wood and coal ranges, which are used in heating kitchens and will frequently shut out the use of electric stoves. For summer, we have no doubt they will be in constant use to the exclusion of any other form of cooking."

Data on Motor Drives in a Massachusetts Printing-Shop

The ratings of motors and methods of connecting them with different machines in the plant of the Davis Press, Worcester, Mass., are given in the accompanying table. With this connected load of about 20.7 hp. the average monthly energy consumption is 1450 kw.-hr., which with the rate of 4 cents obtained makes the bill $58 a month. Many of the motors are variable speed Kimble units, the remainder being General Electric and Peerless motors. Flywheels are employed with most of the motors to absorb peak loads. Friction drive is used with three presses. The energy is supplied by the Worcester Electric Light Company.

Machine Driven	Size, In.	Motor, Hp.	Motor Speed, (R.p.m.)	Pulley Diameters, In.		Face or Belt Width In.	Remarks¶
				Motor	Machine		
Whitlock premier press	41x52	5.0	1300-1800	4.25	20	6	*700-1900 impressions per hour
Whitlock pony press	25x38	2.5	1800	4.00	26	4	*800-2200 impressions per hour
Miehle No. 3 press	33x46	3.0	1800	4.00	18	4.75	*700-2100 impressions per hour
Golding job press	12x18	0.5	Approx. 3 to 1	4.00	42	1.75	*†
Golding job press	12x18	0.5	Approx. 3 to 1				
Chandler & Price press	10x15	0.5	Approx. 3 to 1	4.00	40	1.625	*†
Golding-Pearl press	9x11	0.16	Approx. 3 to 1	2.5	28.5	1.25	*†Hand and pedal control
Standard automatic press	13x19	1.5	1800	2.5	16	2.25	*
Oswego cutter press	38	3.0	1160	4.5	20	3.5	*
Colt's armory press	13x19	1.0	1160	3.75	26	3.00	*
Cleveland folding machine	19x24	0.5	1700	2.25	17	2.00	General Electric motor
Embossing oven	12	0.05	.....	..	..	..	Peerless motor three-part pulley
Miller saw trimmer	..	0.5	1800	3.75	2	1.75	General Electric motor
Monotype machine	..	0.5	1200 max.	2.5	14	1.375	
Monotype machine	..	0.5	1200 max.				
Air pump	..	1.0	1160	2.5	36	4.00	

*Has flywheel. †Friction drive. ¶All motors except those whose makes are indicated are Kimble units.

Additions to Commonwealth Edison Company System Load During Year 1916

The men in charge of the various divisions of the contract department of the Commonwealth Edison Company, Chicago, recently prepared a statement showing the extent of business handled during the last year. Abstracts of these statements, which were published in full in the Edison *Round Table*, are given herewith:

George H. Jones, power sales agent, reported during the year contracts which have been taken for motor service, exclusive of street-railway loads, amounting to more than twice the volume secured during the year of 1915. The net total was 52,300 hp. To secure this load the department closed 3122 contracts, among which were some thirty contracts covering the replacement of large isolated plants.

Oliver R. Hogue, head lighting agent said that the lighting business obtained by the company increased 47 per cent over 1915. This represents a net increase of over 1,000,000 50-watt equivalents during that period. To give an accurate idea of the work of his department in developing and putting into service new industrial heating devices, Mr. Hogue cited the following list of devices which have been developed and put into service during the year 1916: Putty warmers, wax compound heaters, cattle prodders, new type of gluing machines, enameling ovens, drying rooms, electric heaters for oil cars, sand heaters, cloth steamer, seed germinator, heating sprinkler valves, lumber treaters, pyrographic machines, pearl shell heating, printing press ink heaters, bake ovens, fur dryers and optical furnace.

Reporting for the estimating division, W. P. Lyon said that during 1916 the division had handled 3852 contracts amounting to $619,403. This is an increase of 51 per cent in contracts and 88 per cent in the amount of contracts as compared with 1915. In this total were included 3142 house-wiring contracts amounting to $406,908.

A Small Central Station's Safety Code for Its Public

In a handy booklet of electric service information issued by the Wapsic Power & Light Company of Mount Vernon, Iowa, to its customers the following pointers to safety are listed:

"Do not touch any wire that is down on the ground, or hanging from a pole, with hand or foot or any part of the body, no matter whether it is an electric, telephone or guy wire.

"If you find a wire down on the ground, have some person guard it, and notify the electric company at once.

"In an emergency a wire may be moved by using a rake, pitchfork or similar tool with long dry wooden handle, keeping the full length of the handle between yourself and the wire.

"Inside house wiring should be arranged so that it is not possible to stand in the bathtub or be in contact with a water or steam pipe at the time one is touching any electric light socket, switch, or any portion of an electric circuit. Even low voltages have been known to give a shock if received by persons in a bathtub.

"Do not leave your electric flatiron turned on while you answer the telephone or go to the door. It may scorch some valuable cloth.

"Do not have stand lamps, telephones or any other electric devices where they may be placed on radiators or where persons handling same may come in contact with radiators, sinks or pipes.

"In case of trouble with your motor, call a competent electrician or notify the lighting company."

SECURING AND OPERATING SMALL TOWN STREET LIGHTING

Ideas on Tree Trimming Which the Manager of a System of Interconnected Towns Found Valuable in Dealing with Town Boards

BY SAM B. MOTT

Manager Noblesville (Ind.) Heat, Light & Power Company

From the central station viewpoint the subject of street lighting is very important. It assumes prominence, not so much on account of the revenue to be gained, although that is important, but more from the fact that the public judges the electric company by the character of the street lighting service it gives.

In tackling the street lighting problem in a small town the first thing to do is to secure a street lighting contract. This is equally important to the town to be served and to the central station furnishing the service, and should be handled with perfect frankness by both sides. In the making of such a contract the question will arise as to whether the system is to be operated on an all-night or moonlight schedule. This feature alone is worthy of a great deal of consideration. In lighting five small towns on the moonlight schedule, we found that there was more or less dissatisfaction because many of the citizens of the towns thought the lights should be burning regardless of whether the moon was shining or not. For this reason alone, it seems to me that all street lighting contracts should specify all-night operation. The additional cost should not be more than 20 per cent greater and the increased satisfaction obtained would more than pay for the additional expenditure.

Another important consideration in making a street-lighting contract is the location of lamps and the distance between them. It is much better, I believe, to use close spacing and smaller units than long spacing and higher candle-powers. It has been our experience that a 50 cp. or 60 cp. tungsten lamp at each street intersection in the thickly-settled residential sections, and spaced at two-block intervals in the thinly settled portions, gives perfect satisfaction. In the business district it is much better to use 80 cp. or 100 cp. units and a spacing of one-half block. This arrangement will give satisfaction in towns which cannot afford ornamental post lighting.

Another important feature of a street lighting contract is the method of suspending the lighting units. A great many cities use the bracket type of suspension regardless of surrounding conditions. This practice is all right in localities where there are no trees, but in the shaded portions of a town the lamps should be suspended in the center of the street in perfect alignment. There is nothing more pleasing to the eye of the small-town resident than a row of street lamps perfectly in line and all the same distance from the ground.

From 18 ft. to 20 ft. is about the best height to use for such lamps. This of course must depend on the conditions of the trees surrounding the location of the lamp. It has been the custom in the past for town boards to pass tree-trimming ordinances, requiring trees to be trimmed to at least 8 ft. above the sidewalk. Such an ordinance seemed to suit most of the people who had trees to trim. They would trim them to this height from beneath, then hire a tree butcher to cut the top out. While such tree trimming would make a tree unsightly, it was satisfactory in the old days of the kerosene or gas lamp that stood on a post about 7 ft. high.

Modern street lighting with electricity has made it necessary to change ideas on tree trimming. The up-to-date method is to trim trees from beneath to a height of 20 ft. if the size of the tree will permit it and to leave the top without trimming. The result of such trimming is a tree that will let the artificial light shine through and will also allow sunlight to reach the grass and make it grow. A tree so trimmed will afford better all-around conditions and will itself be more nearly what Nature intended it to be.

WHO TO SECURE AS THE LOCAL OPERATOR

The operation of a street lighting system in a small town also presents a problem. The first consideration is the location of switching and regulating apparatus. It has been found that the most practical place for this apparatus is in the town's fire department building or in one corner of the town jail. The last-named place is very practical, for since the open saloon is passing there is no need for a jail of large capacity and there is nearly always enough room to partition off space for the installing of the apparatus.

The next consideration is the arranging for a man to care for the system. His principal duties will be renewing burnt-out lamps and winding and setting the time switch. Even an inexperienced man can do such work. There are two ways to settle this question, one is for the central station to furnish the man and in consequence thereof to charge a higher price for their service, and the other is for the town to furnish the man and as a result to get the service at a lower cost. If the central station furnishes the man, the local telephone lineman is usually selected because in addition to operating the street lighting system, he can install meters and run the service wires for the lighting customers. If the town furnishes the man, the town marshal seems to be the most practical fellow, as he can do the work without interfering with his other duties. The town clerk does this work in one town served by our company and the president of the village board does it in another.

By following plans such as are set forth above I believe it is possible for the average small town or village to have street lighting service that will be as good as city service.

Sales Force Devotes the Month to Bettering Public Relations

During the month of January the outside salesmen of a small Ohio central station were set to work calling on every customer of the company to ask whether or not service had been good during 1916. Each customer was asked the direct question, "Have you any complaint?" The salesmen found that the great majority were entirely satisfied. But where there was complaint everything that is possible was done to remove the cause for it. As many as five calls were made on the same customer to clear away satisfactorily certain misunderstandings.

January was selected as the proper month for the campaign of education because it is a month in which no campaign is conducted on any special device. Furthermore, January is the month in which customers receive high bills and there is an advantage in explaining why these increases occur in the winter, before the customer talks about the higher cost with her neighbor.

It was discovered as the result of this campaign that 80 per cent. of the company's customers were normally "neutral"; they were neither for nor against the company. Of the remaining 20 per cent. one-half were boosters for the company and one-half were complaining. It is believed that the educational campaign changed those who were complaining to neutrals and spurred the boosters to redouble their praises of the company.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

A DUMMY ANTENNA FOR TESTING RADIO UNITS

Installation at Factory in Palo Alto, Cal., Has a Capacity of 0.031 Microfarads

IN the manufacture of radio units of larger capacity than have heretofore been attempted, the Federal Telegraph Company found it necessary to provide for its factory in Palo Alto, Cal., a dummy antenna which could be used for testing Federal-Poulsen arc converters of various sizes. Because of the large units contemplated, and since interference with nearby commercial stations had to be avoided, the type of construction shown in the accompanying illustrations was developed. This afforded capacities up to 0.031 microfarad, and by being of such construction as to have a low effective height caused a minimum of interference.

The antenna consists of five parallel layers of wires spaced 5 ft. apart vertically. The wires in each layer are 2 ft. apart horizontally and there is a 10 ft. clearance between the ground and the lowest point in the bottom layer. The bottom layer, which is grounded, is 136.5 ft. wide with a maximum length of 262.5 ft. The other layers, insulated from ground are 20 ft. shorter and 41 ft. narrower. The insulated layers have fifty-one wires each and the grounded layer sixty-six wires.

The two outer wires on each side of the four top layers are size No. 2, because the edge wires are not shielded so well as the others and it was desired to prevent the corona which would otherwise appear at the edges of these layers. With this exception, No. 14 galvanized telephone wire was used in all layers, and the wires are fastened at each end to 1-in. stranded cables. Although galvanized wire is not generally considered good practice in radio work, it was nevertheless used on this antenna because with the large number of wires employed the resistance could be kept within the usual limits.

For convenience the five parallel layers of the antenna are numbered from the top down. Layers Nos. 1 to 4 inclusive are well insulated, as shown in Fig. 1, and a long length of halyard between the insulation and the supporting towers was provided in order to permit of putting in more insulation with suitable corona shields in case this became necessary at a later date. Obviously, if this were done only layers Nos. 1 and 5 could be used, because the large diameter of shields necessary with such a long string of insulators would otherwise interfere, the layers being only 5 ft. apart. Provision was also made for the installation of corona shields on the insulator strings now used, but no trouble of this sort has been experienced thus far and these shields have not been added.

Beneath layer No. 5 are two single wires which are normally connected and have a separate lead running into the laboratory. These have a capacity of 0.002 microfarad. By various combinations of these wires with different layers of the antenna a considerable number of capacities are available, the maximum being obtained when layers Nos. 1, 3 and 5 are connected as the earth side of the system and Nos. 2 and 4 are connected with the two single wires as the high-potential side. With this combination the capacity is 0.031 microfarad. The jumpers (Fig. 2) used for connecting the various layers consist of 1½-in. copper tube provided with suitable clamps and fittings so that shifting to different capacities is an easy matter. The capacities most commonly used are 0.006, 0.012, 0.017 and 0.024 microfarad. Many others are available.

Before deciding upon the exact lengths of the antenna wires it was noted that with evenly spaced equal load-

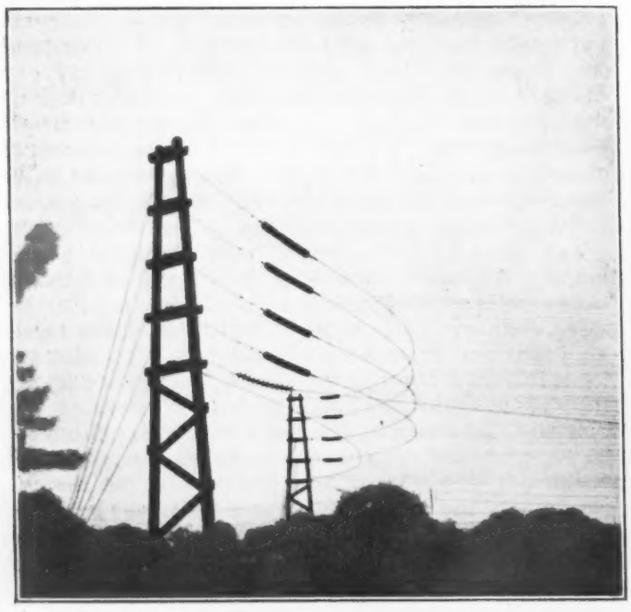


FIG. 1—ALL FIVE ANTENNA LAYERS TERMINATE IN CABLES WHICH ASSUME PARABOLIC CURVES

FIG. 2—ONE END OF ANTENNA, SHOWING JUMPER CONNECTIONS AND LEAD INTO LABORATORY

ing the 1-in. cables to which the wires are attached would assume a parabolic curve. The lengths of the wires in each layer were calculated accordingly, and thus a uniform tension is secured in the individual wires of each layer without excessive pull on the pole supports.

Having tabulated the length of each wire, which was calculated to the nearest 0.01 ft., a convenient scheme was devised for cutting the large number of wires to exact length so as to secure the parabolic curve in the 1-in. cables. Two short posts, exactly 200 ft. apart, were set up on the site with several intermediate stakes between. The wire was unwound from the reel near one of the posts and run out with a "come along" grip to the desired length beyond the second post. A steel tape with its zero on the second post was stretched out beyond it with the wire and the end of the wire was placed at the exact tape reading before signaling.

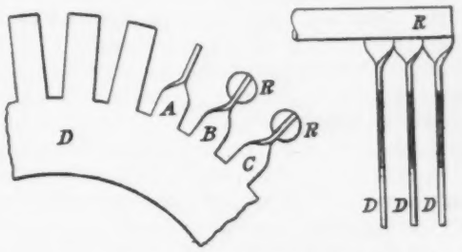
Having the end of the wire held firmly in place on the tape, a man near the reel put steady tension in the wire by means of a "come along" grip until the wire was just raised above the intermediate stakes, and then, upon signal from the man at the tape, the wire was cut with pliers at the first stake. After cutting each individual wire the crew, consisting of two men at each end, proceeded at once to fasten it in place on the 1-in. cable which had been previously stretched, to remove twists, and laid out on the ground in position for hoisting. In cutting the wires, 1 ft. over and above finished dimensions was allowed for connections. A point 6 in. from each end was measured off with a rule, and this point was kept at the inner side of the cable while the end of the wire was given two turns around the cable and sufficient wrapping to secure it.

FIG. 3—NIGHT VIEW OF CORONA WITH ONE LAYER CHARGED

The antenna as a whole reaches the corona point with an undamped high-frequency current of 250 amp. at a frequency of 20,000 cycles. The accompanying night photograph (Fig. 3) shows a layer of the antenna at the corona point during test of a 200-kw. Federal arc converter. The antenna is used by the Federal Telegraph Company and was designed by its engineering staff.

Generators, Motors and Transformers

Squirrel-Cage Motors.—In the use of squirrel-cage motors trouble is sometimes experienced through the connections between the rotor bars and short-circuiting rings working loose. A British company has overcome this by a method of rotor construction using subdivided end rings and brazed joints. Each end ring is made in the form of two, three or four annular disks per side, and thereby a much greater cooling surface is obtained than with a single ring. Fig. 4 shows a portion of an annular disk D of sheet copper, punched with teeth. These teeth are afterwards turned at right angles, as shown at A, B and C, so as to fit into saw cuts previously made in the rotor bar R (see Figs. 4 and 5); after the disks are all in place the joints are



FIGS. 4 AND 5—PORTION OF END-RING DISK AND METHOD OF CONNECTING WITH ROTOR BARS

brazed. A rotor built in this manner is practically indestructible, as there is no solder to melt and the joints cannot work loose.—London *Electrician*, Dec. 22, 1916.

Parallel Operation of Commutating-Pole Machines.—W. B. WEAVER.—After a detailed discussion of the various aspects of this problem the author reaches the following conclusions: The brushes of commutating-pole machines should be placed on the geometrical neutral and should be shifted only as a temporary emergency measure when parallel operation cannot be obtained in any other way. The commutating-pole winding should not be made to function as a series field, and should be used for the sole purpose of insuring good commutation at all loads.—*Elec. Journal*, February, 1917.

Lamps and Lighting

Alternating-Current Arc.—C. D. CHILD.—A paper on the production of light by recombination of ions. The work of Fleming and Petavel on the intensity of the light from an alternating-current carbon arc at different phases was repeated and a similar study was made of the flaming arc and mercury arc in a vacuum. In every case the intensity of the light passes through a minimum without entirely vanishing, and this minimum occurs after the current passes through the zero value. With the mercury arc the minimum intensity occurs approximately 1/1800 second after the current becomes zero. In this case the continuance of the light indicates that the light is due to the recombination of the positive and negative ions, since there is here no chance for oxidation or other known chemical action.—*Phys. Rev.*, January, 1917.

Traction

Tractive Resistance on Curves.—EDWARD C. SCHMIDT and HAROLD H. DUNN.—An account of an investigation carried out at the Engineering Experiment Station of the University of Illinois on the tractive resistance on curves of a 28-ton electric car. The tests were made with a car such as is commonly used on interurban electric roads; it has a body 45 ft. long of the double-end type with round vestibules. This body is carried on four-wheeled trucks which are spaced 23 ft. 3 in. from center to center and which have a wheelbase of 6 ft. 4 in. The car is equipped with four 50-hp. motors, and weighs approximately 28 tons. The tractive resistance of this car was determined when running upon each of seven curves whose curvature varied from 2 to 14.5 deg., and also when running upon adjacent tangent track. The tests demonstrate that for the car in question curve resistance varies directly with both track curvature and speed, according to the formula $R_c = 0.058\ SC$, in which R_c is the curve resistance ex-

pressed in pounds per ton, S is the speed in miles per hour, and C is the degree of curvature.—*Univ. of Ill. Bulletin*, Vol. 14, No. 3, Sept. 18, 1916.

Installations, Systems and Appliances

Alternator Field Rheostat.—F. L. Moon.—A discussion of the question when it is possible to omit alternator field rheostat. A rheostat is required for the purpose of adapting a constant-voltage source of excitation to the varying excitation requirements of the alternator. If the field rheostat is omitted, a suitable source of variable excitation must be provided. The author discusses the types of excitation system, dealing first with the common exciter bus or central direct-current system and with the individual exciter system. He then takes up exciter voltage stability and the range of exciting voltage required at the alternator collector rings. Automatic voltage regulation is finally discussed. The only type of voltage regulator available until recently has, as a part of its main control, a direct-current solenoid, which is energized from the exciter bus. This necessitated the operation of the exciters in multiple, unless a regulator was provided for each unit. There is now available a regulator which has a main control entirely by alternating current and, as a consequence, controls satisfactorily independent exciters, as well as exciters in parallel. And where a separate source is available for energizing the relays, it may be used for a practically unlimited range of exciter voltage. Where an automatic regulator is used, each exciter field circuit includes two rheostats, as indicated in Fig. 6. One is intermittently

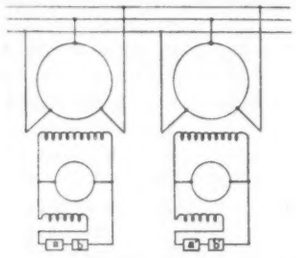


FIG. 6—INDIVIDUAL EXCITER SYSTEM

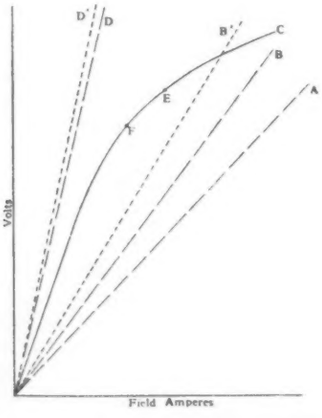


FIG. 7—EXCITER CHARACTERISTICS

short-circuited by the regulator, and the other, known as the equalizing rheostat, is used for hand adjustment. In the diagram a a' are the equalizing rheostats and b b' are the exciter field rheostats. Let the exciter saturation curve be represented by C, Fig. 7, and the volt-ampere characteristic of the exciter field winding alone by A, and with equalizing rheostat included by B. When the regulator contacts are closed—that is, the exciter field rheostat short-circuited—the total field resistance line has the position B, and the exciter voltage builds up. With the contacts open, the resistance in the exciter field circuit is greater than before, and its characteristic has the position D, say; under this condition the exciter voltage drops. The beating of the relays, therefore, causes the exciter voltage to rise and fall alternately, or to oscillate about some mean value, as E. For a different vibration of the regulator, E would be somewhere else on the curve C. A change in the equalizing rheostat also would result in a change of the location of E. Suppose more of the equalizing resistance is used; then B and D assume new positions, B' and D'; and assuming the same vibration of the regulator, the effective resistance of the shunt field circuit is increased, and the exciter voltage will drop to some value F. That this would happen is evident, since the distance between C and B is less than that between C and B', so the tendency of the exciter voltage to build up is less than before, and the distance between C and D' is greater than that between C and D, hence the tendency of the exciter voltage to drop when the relay contacts are open is increased. In this way the exciter voltage responds to readjustment of the equalizing rheostat.—*Elec. Journal*, February, 1917.

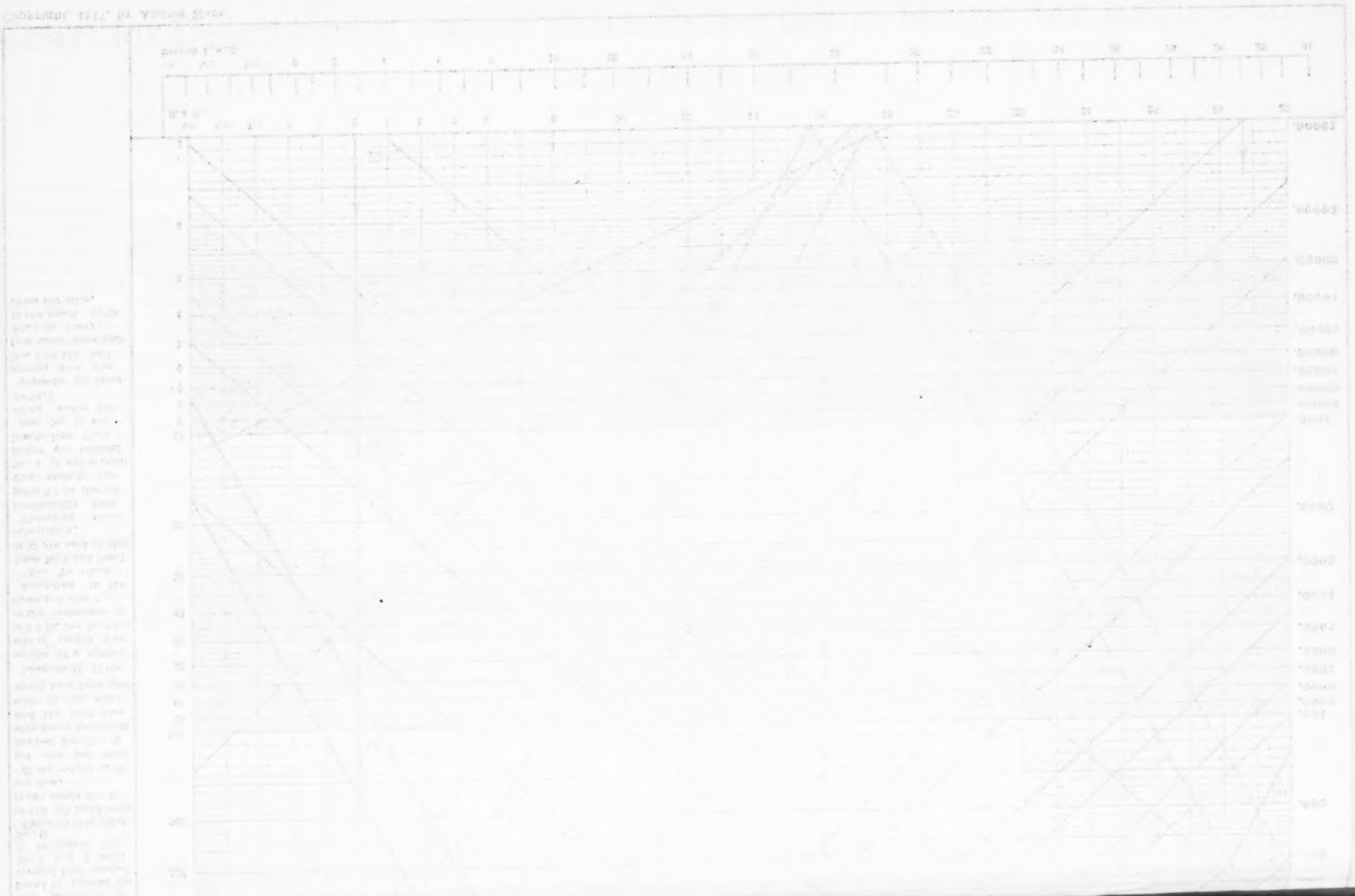
Electrochemistry and Batteries

Aluminum Rectifier.—A. L. Fitch.—An account of an experimental investigation on the counter emf. in the aluminum rectifier. The investigation shows that any method of experimentation in which an appreciable length of time must elapse during the taking of data, the cell being on closed circuit with the battery at least a part of this time, will introduce serious errors due to the change taking place in the cell itself. No attempt has before been made to explain the action of the cell on the theory that the action is due to a double dielectric, one part of which changes with the time of open circuit and the other with time of closed circuit. The present investigation shows that such a theory is plausible and fully explains all the cases investigated. The cell does not attain a steady state after a short time of closed circuit, nor does the single dielectric theory seem plausible. The theory leads to the conclusion that any electrolyte which liberates oxygen on electrolysis may be used in the rectifier. It also shows that other metals than aluminum should be available as anodes, since it only requires the metal to form a compound with the liberated oxygen and that this compound has a rather high resistance.—*Phys. Rev.*, January, 1917.

Electrophysics and Magnetism

Effect of Light Upon the Contact Potential of Selenium and Cuprous Oxide.—E. H. Kennard and E. O. Dieterich.—An account of an experimental research. The contact potential of selenium changes under illumination by an amount exceeding a millivolt for 0.01 candle-foot, and tending to show saturation at a value of about —0.1 volt under strong illumination. The phenomenon is complicated by fatigue effects and a slow drift of the potential with time. No emf. is produced, however, in a closed circuit. The contact potential of selenium relative to freshly sandpapered copper is about —0.4 volt in the dark. The surface potential of a plate of cuprous oxide changed under illumination by about 25 mv., but the plate also contained a small voltaic emf. which varied under illumination.—*Phys. Rev.*, January, 1917.

Emission of Electricity from Incandescent Bodies.—A. Boutaric.—The first part of an article in which the author outlines the facts concerning the emission of negative electrons and of positive ions from incandescent bodies.—*La Lumière Elec.*, Dec. 23, 1916.



No. 2 B & S, line No. 28 and the right hand scale, which [illegible] be disregarded in this case.

The result desired will therefore be found by tracing the vertical line marked No. 2 B & S until it intersects line No. 10

Opposite this point in the left hand scale is the result 1220 lb. per ohm.

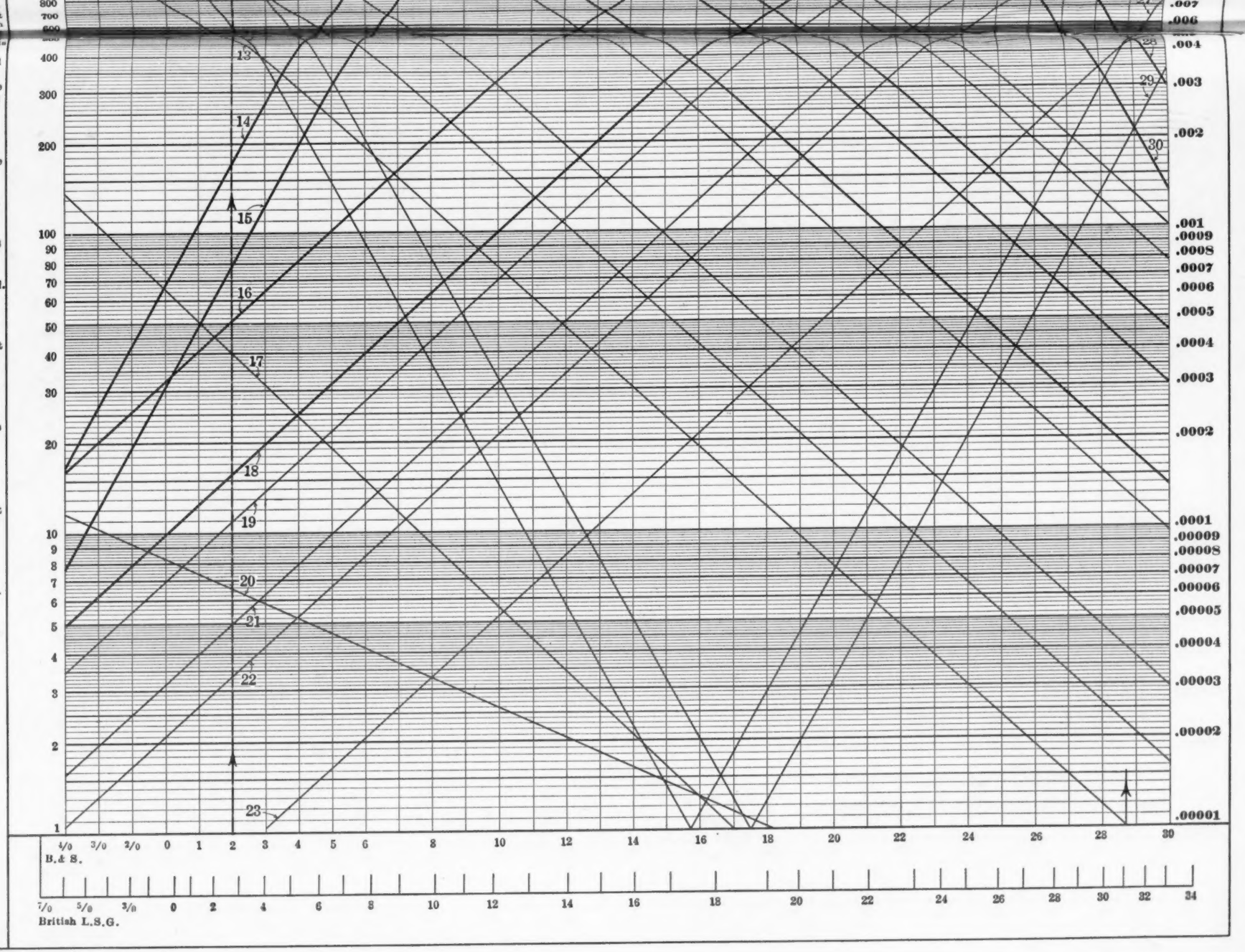
If the weight in lb. per ohm had been desired for No. 26 wire heavy line No. 28 and the bold face scale at the right would have been used.

Example II If the weight of a certain size of copper wire is 0.2 lb. per ft., what is the resistance in ohms per mile ?.

According to the "Key To Chart" lines No. 6 and Nos. 1 or 23 are used in this calculation.

Therefore trace horizontally from point 0.2 on the vertical scale to line No. 6, at which point follow the vertical line to line No. 1 (line No. 23 not being under this point.)

Opposite the intersection with line No. 1 on the bold-face scale (since line No. 1 is heavy) is the result 0.825 ohms per mile.



Copyright, 1917, by Andres Ham.

Chart for Determining Copper Wire Properties in Metric and English Units

Devised by ANDRES HAM
Guadalajara, Jal., Mexico

Supplement to ELECTRICAL WORLD, *Feb.* 10, 1917. (*For description see page* 269.)

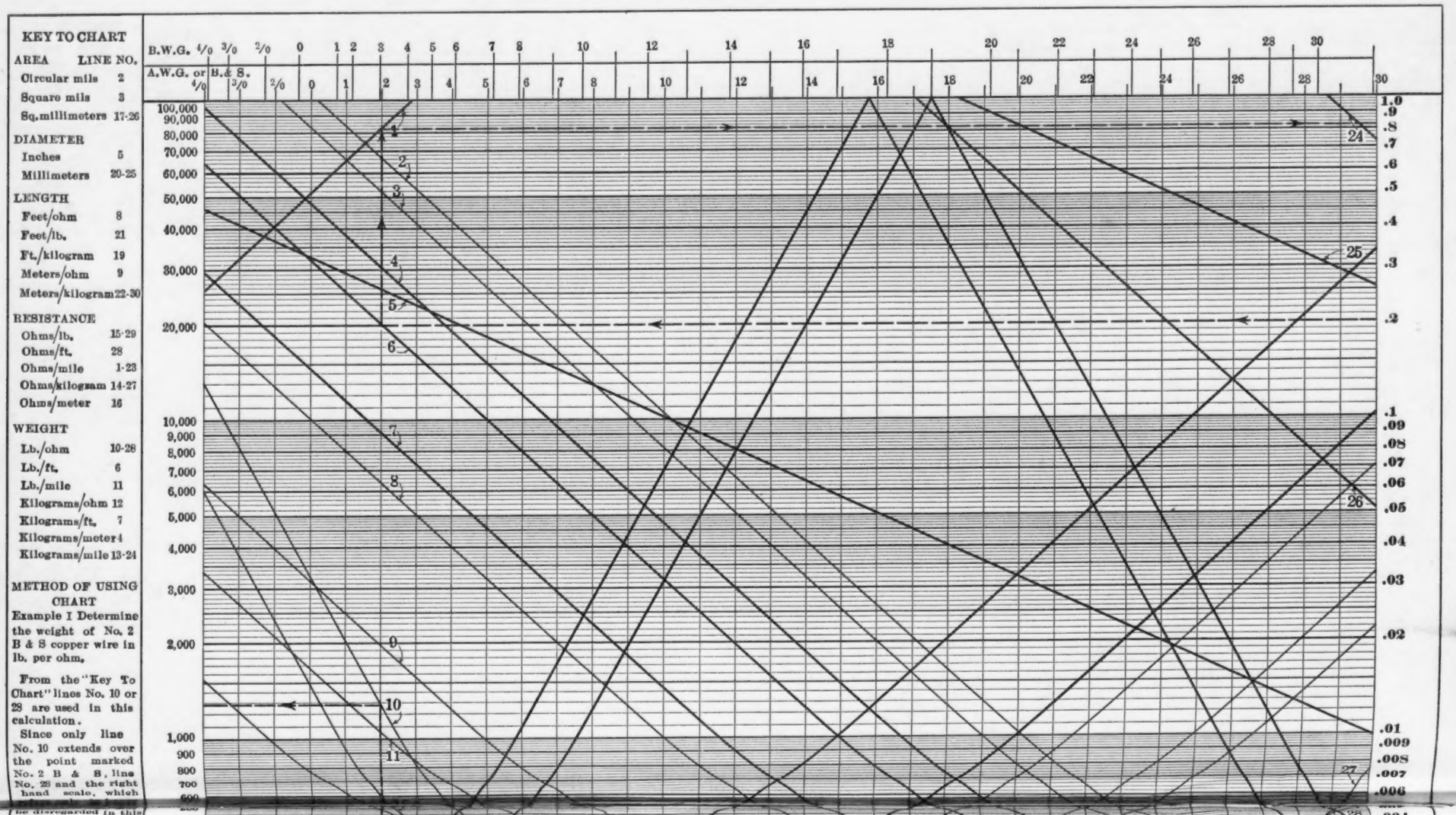


Chart for Determining Copper Wire Sizes in Metric and English Units

Book Reviews

A LABORATORY COURSE OF PRACTICAL ELECTRICITY FOR VOCATIONAL SCHOOLS AND SHOP CLASSES. By Maurice J. Archbold. New York: The MacMillan Company. 222 pages. Illustrated. Price, $1.10.

A manual has been produced by the author that should prove very useful to high school, vocational and practical electrical shop students in carrying out experiments in connection with regular textbook courses. The manual is arranged in loose leaf form so that the teacher may arrange the experiments to suit conditions. Most of the tests are arranged for work with commercial apparatus which gives the student an insight into the kind of work he will be required to do in the electrical field.

To guide the student in working the tests a wiring diagram for each experiment is given in the appendix.

PRINCIPLES OF THE TELEPHONE. By Cyril M. Jansky, B. S., B. A., and Daniel C. Faber, E. E. New York: McGraw-Hill Book Company, Inc. 160 pages. Illustrated. Price, $1.50.

The first of a series of three courses devoted to the principles of the telephone is contained in this volume, which is confined mainly to subscribers' apparatus. The two parts which are to follow, treating of central office equipment and outside construction, are in preparation. Attention is given to both the Bell and the independent apparatus.

It was the intention of the authors that this series of courses should appeal to and be of practical use to men who are actively engaged in the installation, care and operation of telephone apparatus. Judging from the discussion contained in the pages of the first course the reviewer is firmly convinced that the appeal is not made in vain. Simplicity of diction and clearness of both illustrations and text, combine to make the courses of great value to the practical men who wish to know the "why" as well as the "how."

A SYSTEM OF PHYSICAL CHEMISTRY. In two volumes. By William C. McC. Lewis. New York: Longmans, Green & Company. Vol. 1, 524 pages; Vol. II, 552 pages. Illustrated. Price, $2.50 per volume.

The "system" which has been adopted by Professor Lewis as his guide in preparing these two volumes, regards all physical and chemical phenomena as divisible into two groups: (1) phenomena of physical systems in equilibrium and (2) phenomena of such systems which have not reached a state of equilibrium. By choosing this broad classification the author is enabled to show the close relation which exists between many phenomena that appear of remote relationship indeed. The phenomena of each of the two above sub-classes are then discussed: from (1) the classical kinetic standpoint, (2) the thermodynamic standpoint, and (3), the latter, according to the modified principles of statistical mechanics.

Aside from the outstanding feature of this interesting treatment of physical phenomena in a way to facilitate the reader's grouping and retention of separate facts, the volumes have been brought up to date (1916) by including recent investigations on the structure of the atom, thermodynamics of photo-chemical reactions, theory of concentrated solutions, etc. The present work is one of a series of text-books on physical chemistry edited by Sir William Ramsay and issued by the same publishers.

RADIODYNAMICS. The Wireless Control of Torpedoes and Other Mechanisms. By B. F. Miessner. New York: D. VanNostrand Company. 206 pages. 112 illustrations. Price, $2.

This is intended to provide a historical and technical description of the development of wirelessly controlled mechanisms, but is directed toward the military and non-technical scientific reader as well as toward the engineer.

The book opens with a discussion of "wireless" telegraphy, including the obsolete conductive and inductive forms and various modes of signaling by sound and heat waves. Curiously enough, Tesla's earth-conduction scheme is classified under "electromagnetic wave systems." The central portion of the book gives some descriptive matter relating to various early attempts at wireless control of boats, airships and torpedoes, and the author then takes up in some detail the work of J. H. Hammond, Jr. (whose assistant he was) in improving the military value of such devices. Various problems of interference prevention, relay operation, etc., are discussed and the author's suggested solutions described. Some ingenious proposals are brought forward, though the treatment is largely amateurish from the radio-engineering standpoint. The author seems to share the dislike of the term "audion" which exists in some quarters, for he calls this device the "Potentio" detector throughout his book. In spite of its evident weaknesses, however, the reader is likely to find some information of interest in the descriptive chapters.

THE EMISSION OF ELECTRICITY FROM HOT BODIES. By O. W. Richardson. New York: Longmans, Green & Company. 304 pages. Thirty-five illustrations. Price, $2.75.

The last few years has seen the commercial development of rectifiers such as the kenotron and the successful use of wireless detectors and amplifiers such as the audion, both pieces of apparatus depending for their action on the emission of electrons from hot filaments. In order to appreciate the possibilities and also the limitations of such apparatus the engineer should know something of the work that has been done on thermionic currents as recorded in this new text.

After a brief historical review of the experimental data and of the theories developed to explain the results obtained, the author derives the law of variation of emission of electrons with temperature, assuming that the laws that govern the escape of the electrons are the same as those that govern the increase in vapor pressure of a liquid with increase of temperature. The experimental data on the emission from metals and from compounds is then critically analyzed, one chapter being devoted to the effect of gases, and the conclusion is reached that the electron emission is caused by temperature and not by chemical action.

The second half of the text deals with the emission of the positive ions that are found when the temperature is not too high. This consists of a transient emission from fresh wires due to impurities and a permanent emission found when the material is heated in an atmosphere of various gases. The experimental data on the emission from heated salts is then examined, and the text closes with a short discussion of a number of cases of gaseous ionization whose origin is generally assigned to chemical action.

The book is written principally for physicists, and does not give an account of the technical developments of the subject. It is a mine of information, and should be a source of inspiration to electrical engineers, by whom it can be read without difficulty.

Concord Municipal Plant Not for Sale

To the Editor of ELECTRICAL WORLD:

SIR:—I have before me your edition of Jan. 20, 1917, and have noted with astonishment the statement contained in the last paragraph of the article on page 123 entitled "Municipal Plants Should Share Cost of Regulation" that "Considerable headway has recently been made in two important," we certainly appreciate the word important, "instances (Concord and Westfield) in projects for the sale to privately owned companies of existing municipal plants."

In order that you may know the facts of the case, we are forwarding, under separate cover, a copy of our report for the year ending Dec. 31, 1915, and please note that the writer is alone responsible for what has taken place in Concord, Mass. "Business is business" and "a penny saved is a penny earned," but the voters of the Town of Concord did not wish to even consider the proposition and the Municipal Light Board and Manager of the Plant had the only contest with the voters of the Town since the plant was established to get a majority to vote for a committee of nine to look into the matter. After a strenuous contest it was voted that a committee be appointed and following a thorough investigation the committee unanimously voted against the purchase of current from outside sources.

Would you say that "Considerable headway has recently been made in projects for the sale to publicly owned plants of existing privately owned plants" if a private company approached a municipal plant and asked it to make a proposal to furnish current wholesale on its switchboard? I am quite sure that you would not, and in the opinion of the writer it is just as good business for a municipal plant to take advantage of any possible method of reducing its expenses.

Do you believe that either the Boston or New York Edison Companies would meet our rates were they supplying a residential community of 6000 people? The census gives Concord, Mass., 6500 but please note that at present we have a population of about 500 in the Massachusetts Reformatory that does not help our plant one bit. We serve a scattered community and have a plant investment of $181,000 and more than $71,000 is in lines alone with transformers and meters, making a total outside investment of $93,000.

For your information we are also forwarding a copy of our Rates, Rules and Regulations and would call your especial attention to our cooking and heating rate. We shall be pleased to forward our report for the year 1916 when it is received from the printer.

Facts are facts and when we stick to them we can harm no one. It seems to the writer that in fairness to Concord such erroneous reports should not be broad-casted all over our country. If municipal ownership of public utilities is an absolute failure it cannot be long hidden from the public for as our martyred President Lincoln said "You can fool all of the people some of the time and some of the people all of the time but you cannot fool all of the people all of the time." This applies to municipal as well as privately owned plants.

A. W. LEE,
Manager Concord Municipal Light Plant.

Readers' Views and Comments

Saving $1,000,000 on Street Lighting

To the Editor of ELECTRICAL WORLD:

SIR:—While the Chicago street lighting system requires the installation of a further 30,000 lamps to the already existing 34,000, the War Department has recommended that the flow of water through the Sanitary District's power house at Lockport be reduced one-third of the existing 6500 cu. ft. per second. This would mean a reduction of 11,333 lamps, whereas there is need for an actual increase of 30,000 lamps during the next three or four years.

With the inability to obtain further power from the Sanitary District's station, because of the War Department's recommendation, the obtaining of requisite power has become imperative to meet the needs of future lamp increases.

Due to efficient co-operation between Commissioner W. G. Keith, of the department of gas and electricity, and the city engineer a solution has, however, been found which will be economical to both departments, and which will, it is estimated, effect a saving of 25 per cent in operating lamps.

The growth of the city has necessitated the construction of a number of buildings such as an Isolation Hospital, a bridewell, municipal shops and foundry. These buildings, grouped together, require a heating plant of considerable size; but while requiring heat during the daylight working hours this heat, or a large portion of it, would go to waste during the remaining twenty-four hours. Through co-operation between the electrical department and the city engineer arrangements have been made to utilize this heat for street lighting between the hours of 4 p.m. and 7.30 a.m. A steam turbine and generator will be installed, its power being used in the city shops, bridewell, etc., during the day, and by the city's street lighting during the night, thereby effecting economy to both departments. Now that the problem of obtaining an economical source of power is solved the entire proceeds of the $3,750,000 bond issue approved by the people last June will be devoted to line construction and other work necessary in connection with placing the 30,000 additional lamps in service.

These lights will be installed in territories not at present lighted and also improve the illumination in districts insufficiently lighted. Not the least important improvement in the proposed installation over those of previous years is that the lamps in residence districts will be operated at a low voltage, thus reducing the liability of injury and fatal accidents in those instances where persons come into contact with live wires. The immediate saving by eliminating the need for constructing a generating station for street lighting will be $1,000,000, and is made possible by co-operation of the department of public works and the department of gas and electricity, a co-operation which it is expected will increase with time and as it increases will proportionately inure to the benefit of the city.

GILBERT RUTHERFORD.
Evanston, Ill.

Suggestion That Will Make Scientific Data Available to All

CAMBRIDGE, MASS., Jan. 26, 1917.

To the Editor of ELECTRICAL WORLD:

SIR:—The undersigned committee on engineering of the general committee on research of the American Association for the Advancement of Science feels that it is timely to issue the following appeal to the industrial research laboratories of the country.

In the course of work done in the numerous industrial laboratories of America, many physical and commercial constants and data of great scientific interest and value are doubtless arrived at and which may, for a certain period of time, constitute an asset of considerable commercial value to the particular corporations in question. During this period everyone recognized the proprietary right of the industrial laboratories to the retention of this information.

A time frequently arrives, however, when such scientific information loses its commercial value (often by being duplicated in other laboratories), and just at this point we wish to impress upon the industries their obligation to enrich scientific literature with such facts and data, which might otherwise be lost or forgotten.

Some of our industries have been reproached with the suspicion of acting as sponges, in that they absorb an immense amount of useful information from scientific literature without giving any return in kind. This suspicion would be entirely removed if, from time to time, scientific information which has ceased to be of commercial value were contributed by them to its appropriate channel and thus became available to all scientific workers throughout the world.

If any doubt exists as to the appropriate channel for the publication of such scientific data and communications, the secretary of the A. A. A. S., Dr. J. McKeen Cattell, Garrison-on-Hudson, New York, will be glad to act as intermediary and to forward such communications to the proper scientific body.

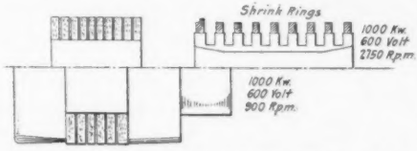
A. E. KENNELLY, J. W. RICHARDS, A. SAUVEUR, A. N. TALBOT, C. C. THOMAS

Output Limitations in Direct-Current Machines

To the Editor of ELECTRICAL WORLD:

SIR:—The writer appreciates the opportunity which you have furnished for publishing my reply to a letter by Prof. Miles Walker simultaneously with his comment on my article published in the Oct. 21 issue of the ELECTRICAL WORLD.

In that article I showed that if the maximum voltage between segments is limited to 30 to prevent flashing over, the number of ampere conductors per inch to 1000 to limit the armature heating, and the peripheral velocity to 9000 ft. per minute so that standard construction may be used, then the maximum permissible speed of a machine for a given output is fixed and in the particular case of a 1000-kw. machine must be less than about 1200 r.p.m. for a 600-volt commutat .. I then indicated that this limit was exceeded in Europe and cited the case of a 1000-kw., 600-volt, 2750-r.p.m. direct-current generator designed by Professor Walker



ESSENTIAL DIFFERENCES IN 2750 R.P.M. AND 900 R.P.M. 1000 KW. MACHINES

and showed that, to make such a machine possible, each armature coil had to be tapped by a commutator lead so as to give two commutator segments per coil instead of one, that the peripheral velocity of the armature was 17,300 ft. per minute and the rubbing velocity of the commutator 10,000 ft. per minute.

The essential differences between a 2750 r.p.m. and a 900 r.p.m. machine of 1000 kw. may be seen from the accompanying sketch. The constants of interest are,

Kw.	1,000	1,000
Volts	600	600
R.p.m.	2,750	900
Poles	4	6
Armature, dia., in.	24	36
Core length, in.	21	15
Max. tooth density, lines sq. in.	94,000	135,000
Core density, lines sq. in.	68,000	85,000
Frequency, cycles	92	45
Arm, surface vel., ft. per min.	17,300	8,500
Comm. rubbing vel., ft. per min.	10,000	5,000
Amp. cond., per in.	800	880
Circ. mils per amp.	550	450
Average volts per seg.	17	20

I greatly regret that any remarks I made should have seemed like criticism of Professor Walker's design. If I were compelled to build a machine of 1000 kw. to run at 2750 r.p.m. I should copy his design, which is quite liberal electrically, but I would say my prayers regularly while the machine was in operation, because on this side of the Atlantic we have not had the long experience of ultra-high-speed commutators enjoyed by the European builders. One of the large American companies which offers a line of direct-connected turbo units and also a line of geared units has not received an order for one of the former machines in the last twelve months. The operating companies evidently do not like the high-speed machine.

The original article was really written to defend the present American practice in motor generator speeds as against the 50 per cent higher speeds used in Europe for the same output, and I wish to take this opportunity to express my appreciation of Professor Walker's present book.

ALEX. GRAY.

Cornell University,
Ithaca, N. Y.

The Passing of Brother Potamian

To the Editor of ELECTRICAL WORLD:

SIR:—The regularity with which fortune favors institutions of learning by bequeathing to them the hallowed associations incident to the life-work of great members of their faculties is singularly fortunate. The roll of men preeminent in any department of progressive thought who have been intimately identified with the life of a university or a college always constitutes one of the most worthy elements of its atmosphere.

Albany Academy, had its Joseph Henry; Glasgow University, its Kelvin, and a long list of other seats of learning could be made showing similar associations.

Manhattan College, in New York, may have other claims to greatness based upon academic achievement; but in the realm of electrical science its name and that of Brother Potamian are synonymous.

Of inestimable value to the human race is it, that periodically there arrives a man, gifted, competent to achieve success in whatever walk of life he may enter; but who, possibly in answer to divine precept, pauses to analyze and record the achievements of other men. In technical literature Brother Potamian's monumental work was "The Makers of Electricity," in the writing of which he collaborated with Dr. James J. Walsh, of Fordham University. This is probably the most complete account we have of the biographical history of electricity, from Peregrinus to Kelvin.

Brother Potamian was ever alive to the value of exact record, and never knowingly passed by an opportunity to keep straight the truth of electrical history. In an editorial appearing in the ELECTRICAL WORLD and ENGINEER, some years ago, the question was raised as to whether Benjamin Franklin ever actually performed the *kite* experiments with which his name is associated; and if so whether he was not anticipated by M. de Romas, in France. To the Jan. 20, 1906, issue of your journal, Brother Potamian contributed a masterly review of the evidence in the controversy which should establish for all time the fact that Franklin undoubtedly was the first to employ a kite in electrical investigation.

As Brother Potamian has said of others, so it may well be said of him: "The lives of such men, who were inspiring forces in their day, are as illuminating as they are instructive and encouraging. Perhaps never more than now do we need such inspiration and illumination to lift life to a higher plane of purpose and accomplishment than that to which it is so prone to sink when material interests attract almost exclusive attention."

DONALD MCNICOL.

New York City.

Ground Detector Using Three Voltmeters

To the Editor of ELECTRICAL WORLD:

SIR:—The writer was greatly interested in the article by George E. Armstrong that appeared in the Dec. 9, 1916, issue of the ELECTRICAL WORLD, page 1145, and described a type of ground detector in use on the lines of the Southern California Edison Company.

The principle of the ground detector mentioned is almost identical with one that has been in use on the Brooklyn Rapid Transit System for the past seven years. The chief difference is that the Brooklyn company makes use of three voltmeters connected across the secondaries of the transformers in place of the three lights used by the Southern California Edison Company to give the visual indication.

A. K. MILLER.

Brooklyn, N. Y.

Eliminating Danger from Transil Oil

To the Editor of ELECTRICAL WORLD:

SIR:—The review of a German paper which appeared in the ELECTRICAL WORLD of Sept. 9, 1916, page 533, and discussed the possibility of reducing the inflammability of transil oil by its admixture with carbon tetrachloride, emphasized the fact that at the present time transil oil is a necessary evil, possessing a remarkable number of faults. The use of carbon tetrachloride is a move in the right direction so far as it goes. The trouble is that it does not go very far. Tetrachloride is extremely volatile, hence in mixing it with oil the element of uncertainty must be always present as to whether the oil is actually inflammable or non-inflammable, while the fact that it attacks brass and copper, is used commercially as a solvent for rubber, and is rather a powerful anæsthetic under certain conditions all mitigate against its use.

There is no doubt but that operating engineers would welcome a satisfactory and reliable substitute for transil oil, one that is non-inflammable and one without the hygroscopic characteristics of transil oil. Could such a substitute be found, and it no doubt will in time, insurance rates will be materially reduced as will also the relatively high costs for fireproof construction and other precautionary measures now in vogue for preventing fires and for permitting the oil to be removed from the danger zone quickly and safely. A sub-

stitute which is non-hygroscopic will do away with the great care in handling and housing oil-cooled and oil-insulated apparatus, which is now necessary to guard against the absorption of moisture by the oil, and the rapid reduction of its dielectric strength.

The hygroscopic and inflammable nature of transil oil often works considerable hardship, for the smaller companies especially, who cannot afford effective but costly construction methods, and thus prefer to carry their own insurance rather than pay the high rates charged. Trouble is however often encountered by the larger companies on account of the opposition of the insurance interests against their installing oil-filled apparatus in close proximity to property upon which they are carrying the risk. The best example of this is the substations and transformer vaults now coming into increased usage by the larger companies to supply their customers using considerable power. These vaults or commercial substations usually are designed for oil-cooled apparatus because of the lesser space factor and attention required by them. Of course, air-cooled apparatus could be used where space permits, although the element of risk would even then not be altogether absent, while the additional cost of motor-driven blower, increased cost of operation and supervision would be strong deterrents. These transformer stations or vaults are often located right in the midst of a factory building or other load center to permit of economical distribution, low copper investment and voltage drop, etc.

For several years past one company has eliminated transil oil in some of its instrument transformers for both its own stations and those of its customers. This company uses potential transformers of 200 watts capacity on its 11,000, 1320 and 20,000-volt circuits, and it is the transformers for the two lower voltages which have an insulating medium other than transil oil. Instead of transil oil a solid insulating medium is employed. This compound solid at temperatures below about 40 deg. C. liquifies at higher temperatures. The transformer and case are warmed and the warm compound injected, when, the transformer cooling, the whole becomes a solid mass. If properly done, all interstices are filled and air pockets avoided. There are many advantages of employing such a medium. The transformer cannot very well be placed in service without the insulating medium—as sometimes occurs where oil is used—because the compound is injected by the manufacturer; since the medium is solid it cannot spill during shipment or leak through the case, nor "breath" due to atmospheric changes or absorb moisture. On the other hand, its solidity must surely make it rather troublesome to repair the winding; the possibility of air pockets forming and the possibility of ionization of this air followed by disintegration of the insulation and final failure seems not out of the question. Perhaps the greatest apparent objection to a solid insulation medium is that it is not self-healing, that is to say, if an arc starts, a liquid such as oil may quench it, whereas with a solid material, with zero viscosity for the time being, serious damage could be done before the medium melts and starts to flow, and thus interpose a high resistance barrier in the path of current flow. Solid insulation compounds have been used from time to time in small-capacity transformers designed for voltages up to about 60,000, and have proved useful where movement of the unit from place to place is frequent, because of the absence of leaks, spilling, etc., but the probable limit is thought to be in the neighborhood of 5 kva., although this might be exceeded by suitable design to prevent hot spots. Such a design, for a given regulation, would, however, not be the most economical.

R. I. ELKIN.

New York City.

Work for Technical Journalists in Science and Engineering

To the Editor of ELECTRICAL WORLD:

SIR:—In the ELECTRICAL WORLD for Oct. 14, 1916, is an editorial reference to a valuable function to be exercised by the scientific and technical press in bringing about closer relations between science and engineering. A recent movement initiated in England for this purpose may interest your readers. This movement is an attempt to promote co-operation between technical journals and universities on matters of common interest, and during the last few months steps of interest have been taken to establish this closer relation. For some years there has existed in England a Circle of Scientific, Technical and Trade Journalists, which is the section of the Institute of Journalists chiefly interested in scientific and technical matters. The very wide and active discussion that has been going on regarding the application of science to industry and the improvement of technical education in this country has shown clearly the need for fuller co-operation between engineers and scientists and the paramount importance of influencing public opinion in the right direction so that science may hold a higher place in public esteem. The war presents difficulties in the direction of any widespread educational movement, since most of the colleges have to a greater or less extent a depleted staff of instructors and of students, and those who remain are necessarily concentrating much of their attention on special work arising through the war. What can be done now is to inaugurate a campaign of education with the object of influencing the public, and particularly the manufacturers, to recognize the value of applied science, so that the ground may be prepared for future efforts. Toward this end the press can do good service, and the circle has already commenced work. The first requirement is obviously that journalists should themselves be well informed regarding modern ideas of education and research, and the steps that the authorities may rightly be expected to take for their encouragement. Accordingly, at several meetings of the circle papers have been read by leading authorities in the scientific field and discussed by the editors of technical journals. These discussions have been given wide publicity by the scientific and technical press. Among the papers may be noted one by Dr. William Garnett, late educational adviser to the London County Council, on "The Sphere of the Scientific and Technical Press in Relation to Technical Education and Research," and a similar paper by A. P. M. Fleming of the British Westinghouse Electric and Manufacturing Company, which dealt mainly with industrial research and gave an interesting account of the developments in this direction in the United States. Following these meetings steps were taken with a view to bringing about more cordial relations between the press and the leading universities.

On May 31 members of the circle were invited to the Imperial College of Science by the Rt. Hon. Arthur Dyke Acland and were shown over the chief departments by the professors, and given interesting examples of the special work which the college is now doing.

This precedent has since been followed by the Universities of Leeds and of Sheffield, which invited the circle to form a party of journalists to visit these cities from Oct. 10 to 12 as the guests of the universities. They visited the various departments of pure and applied science, inspected local factories associated with the work of the universities in these cities. In many respects the work of these two educational centers is unique, Sheffield being the center of the steel industry in England, while at Leeds there are important sections devoted to leather, color, chemistry and textile work. At both universities a considerable amount of special research work is being carried out in connection with the war, and the laboratories have been organized to devise processes for the making of material hitherto imported from abroad.

It is hoped that closer and more cordial relations between the universities and the press will follow, and that the circle will also be useful in influencing public opinion in other ways. For example, the problems arising in munition work at the present time have brought vividly home to the English nation the need of scientific management and welfare work. These are matters that require constantly to be brought before manufacturers, and the press can do valuable service by keeping the public informed. A step in this direction was taken with the reading of a paper on "The Human Element in Factories" by B. S. Rowntree, Director of the Welfare Department of the Ministry of Munitions of War, at a recent meeting of the circle.

These are only a few instances of the good work to be done by co-operation between the universities and the scientific and technical press, and a broad development of the plan seems possible.

J. S. DOW.

Shepherd's Hill, Highgate, N., London, England.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

INDUSTRY HASTENS TO THE AID OF THE GOVERNMENT

Electrical Plants and Fully Equipped Laboratories and Personnel Placed at Disposal of Government in Numbers

The United States of America, so far as industry is concerned, is rapidly being placed upon a war basis. Reports from Washington show, as the result of the notification on Jan. 31, 1917, of the German government, that unrestricted submarine warfare will be resumed notwithstanding the protests of the United States. A military war basis is also being brought about, to a certain extent.

The "mobilization of industrial resources" which has been so much talked of recently, is, in fact, now being given a practical test. Secretary Daniels of the Navy Department and Secretary Baker of the War Department have been in daily conference with members of the Naval Consulting Board and the National Defense Council. There have been filed with the navy department inventories of 1200 manufacturing plants which could produce war material, and a great many manufacturers of all classes of machinery, chemicals, etc., have placed their plants and their personnel at the disposal of the government for use if needed.

One of the outward signs of the mobilization to be seen in Washington is the fact that the State, War and Navy building has been closed to visitors. The government departments at Washington do not desire calls from contractors, builders, engineers, salesmen, etc. They can not even obtain access to the departments except upon written passes issued before Saturday, Feb. 3, and every employee, from cabinet officers and the chiefs of staff of the army and navy down, is obliged to present such passes to the sentries on duty. Representatives of the industrial resources of the country who have material to offer the government must make their offers in writing and send them by mail.

The government is placing contracts in some cases without bids and in other cases is about to ask for bids for millions and millions of dollars' worth of equipment—all sorts of machinery and supplies, which would place the country upon a war footing. Immediate purchase of reserve supplies, depleted because of the last Mexican crisis, has been ordered, and War Department purchasing agents were, on Wednesday of this week, sent out into the open markets to obtain these supplies.

There is no question that there will be written into the navy bill authorization for the Secretary of the Navy to take over for the government any private plant the government may need in a war emergency. The government has already practically taken over the private radio plant at Tuckerton, N. J., and within the past few days has replaced the civilian operators with United States navy operators. Telephone, telegraph and wireless companies all over the country have offered their services and their plants to the government, and upon one occasion immediately following Germany's announcement, the afternoon of Feb. 1, a practical test of governmental use was put into effect on long distance telephone wires out of Washington.

Early in the week when it became apparent that a national crisis was fast approaching, the electrical manufacturing plants of the country in numbers hastened to put their manufacturing facilities at the call of the government. These plants, operated as they are by engineers of practically all kinds, and the output of which has been developed only after long periods of careful research in the best equipped laboratories in the world, are undoubtedly in a position to furnish the government with such manufacturing assistance as cannot be found in any other industry.

Many plants have been occupied for some time in manufacturing munitions for England and her allies and as in most instances, these war contracts have been fulfilled, the plants are now thoroughly equipped to furnish munitions of war in large quantities in a short time. The last eighteen months have been fruitful in gaining experience in the manufacture of munitions.

Electrical manufacturers in offering their plants to the government had been careful to state that every branch of the company's service is at the disposal of the government. To the government this is significant, for in addition to the manufacturing facilities, many of the large electrical manufacturers maintain engineering laboratories equipped and manned to quickly and efficiently investigate practically any engineering problem that might arise. It will be remembered that the Naval Consulting Board at the very outset recommended the expenditure of a large sum of money for the establishment of a research laboratory where specialists would study problems connected with warfare. By their action, the electrical manufacturers have now placed at the disposal of the government, laboratories and engineering specialists in a position to investigate the very problems and conditions which the Naval Consulting Board had in mind.

REDUCTION IN RATES OF QUEENS BOROUGH COMPANY

Voluntary Offer of 12-Cent Maximum Rate Without Condition That Gas Business Shall Be Considered Too

Carleton Macy, president of the Queens Borough Gas & Electric Company, has proposed a voluntary reduction in the maximum rate for electricity from 13 to 12 cents per kilowatt-hour, effective on March 10. The announcement was made on Jan. 31 at a hearing before the New York Public Service Commission of the First District.

At a previous hearing, reported in the ELECTRICAL WORLD for Jan. 13, 1917, Mr. Macy stated that the consent of the company to a reduction in electric rates was based upon the condition that when rates were taken up both gas and electric should be considered. When the commission raised the point that it would scarcely be justified in considering the electric and gas business together, Mr. Macy withdrew his suggestion for further consideration. During the hearing of Jan. 31 he said that the reduction would be made without any conditions.

The proceeding by the commission to determine

whether the electric rates of the company should not be reduced will be continued notwithstanding the voluntary reduction proposed by the company. Engineers and accountants of the commission are making a study of the property.

NO ACTION ON STANDARD TERMINALS BY N. E. L. A.

Wiring Committee Has Not Taken Definite Position on the Question of Flat Versus Round Prongs on Flatirons

R. S. Hale of Boston, chairman of the wiring committee of the National Electric Light Association, has called our attention to the fact that the report of the recent meeting of the wiring committee has been misinterpreted so as to give the idea that the committee has taken a definite position on the question of flat versus round prongs on flatirons. The largest manufacturer of flatirons in the country has sent out a circular under date of Jan. 24, stating that there is a distinct sentiment in favor of flat contacts, either parallel or tandem, on separable plugs, and that the committee adopted a resolution suggesting to the manufacturers that the round contacts be dropped.

Mr. Hale informs us that this is not the case. He said "the wiring committee has attempted to arrange a conference of the manufacturers. If that conference should recommend either flat or round prongs, the wiring committee would welcome such action as a step toward standardization.

"If the conference should divide between flat and round prongs, then probably the best thing would be not to attempt to standardize until experience has shown which is best.

"The wiring committee endeavors to accomplish standardization by getting the manufacturers to agree, and until they agree the report of the wiring committee should not be regarded as in any way indorsing any one design as compared with any other."

CENTRAL STATIONS TAKE STEPS TO PROTECT SERVICE

Significance of War with Germany No Longer Underestimated, Especially as So Many Industrial Plants Depend Upon Electrical Power

As the war cloud hovers over this country, the significance of actual hostilities becomes more and more apparent to the central station operators. Guards have been thrown about plants and the coal piles, in order to ward off any malicious attempt to destroy property or otherwise injure service. Lighting plant managers who have been off on vacations are hurrying home in order that they may be at their plants should any emergency arise.

While there is sufficient coal at the present time, there is ever the danger, should a break come with Germany and her allies, of a serious shortage of fuel. It is no secret that a great majority of coal miners are of a nationality whose sympathies might, in case of a break, be with the Fatherland. There is also the chance that coal mine operators fearing violence on the part of the miners might refuse to allow those of Teutonic birth, to enter the shafts if the Government does not actually intern them. Such action, it is almost certain, would mean the closing down of most of the great coal mines.

In view of the fact that so many of the nation's industries depend upon electricity for power, a number of which would be called to the aid of the government should war actually occur, the maintenance of service becomes of greater importance than ever. It is for this reason, probably more than anything else, that central station operators are using such care at the present time to protect their properties. In this connection, the action of the Boston Edison company is an example of what is being done in other parts of the country.

Special precautions have been taken at the L Street and Atlantic Avenue generating plants of the Boston Edison company against damage in case of hostilities between the United States and Germany. Both stations are being flood-lighted and strong police protection has been provided on both a day and night basis. Barbed wire has been erected around the station property, this precaution also having been established at the company's general service buildings on Massachusetts Avenue.

BROOKLYN ELECTRICAL MEN MEET AT ANNUAL DINNER

Over Five Hundred Hear Addresses by W. F. Wells, Irving T. Bush, Oswald F. Quist, L. H. Pounds, Travis H. Whitney and J. W. Lieb

The eleventh annual dinner to the electrical men of Brooklyn was held at the Academy of Music, Brooklyn, on Feb. 1. The affair was attended by more than 500 men, a great many of whom are prominent in industrial enterprises, among whom were Elmer A. Sperry, inventor of the gyroscope; Irving T. Bush, president of the Bush Terminal Company; John W. Lieb, vice-president of the New York Edison Company; T. C. Martin, secretary of the National Electric Light Association, and three public service commissioners. T. I. Jones, general sales agent of the company, as toastmaster, introduced the speakers, who spoke on the subjects noted: W. F. Wells, vice-president of the Brooklyn Edison company, "Brooklyn and the Brooklyn Edison Company"; Irving T. Bush, "Brooklyn as an Industrial Center"; Oswald F. Quist, president of the Kilowatt Club, "The Contractor and the Company"; Lewis H. Pounds, borough president, "Brooklyn's Future," and Travis H. Whitney, public service commissioner, "The Public Service Commission." J. W. Lieb also spoke informally.

The theme of the dinner was "Industrial Brooklyn," and was strictly a "Boost Brooklyn" affair, the slogans in electric letters, "Brooklyn for All" and "All for Brooklyn" exemplifying this idea. The banquet hall was lighted by hidden flood-lighting projectors in colors, which gave a beautiful vari-colored effect that was spectacular to the extreme.

RELIEF PLANNED FOR THE BOSTON ELEVATED RAILWAY

Special Commission Recommends Two Measures, One Laying No Burden on Public and Other Costing Public Something

When an electric railway serving a metropolitan community as large as Greater Boston, with no "water" in its capitalization, and with a notably efficient management, appeals for financial assistance, the disposition of its case becomes of general interest to public utility men. The special commission which has been investigating the Boston Elevated Railway Company's finances has just made its report to the Massachusetts Legislature, and it is noteworthy that two classes of relief measures are recommended: First, measures which will

not lay any burden upon the public, and, second, measures which may actually cost the public something.

Under the first head fall the sale of the Cambridge subway by the company to the State, the return of $500,000 guarantee fund deposited with the State in the early days of the company's history, the grant of the right of eminent domain for the establishment of free bodily transfer inclosures where the abuses of paper checks will be eliminated, the temporary capitalization of replacements and the institution of a graduated rental for new subways, so that the burden of these last can be gradually assumed as these costly structures grow in usefulness. Under the second classification fall a certain reduction in taxation based upon earnings and representing seven-eighths of 1 per cent of gross. No increase in fares or charges for transfers is favored at this time, but the commission believes that if the measures recommended are granted the company's financial needs will be met for at least three years. A detailed investigation by the Public Service Commission, with an appropriation for expert assistance, to inquire into the efficiency of the company's administration and to report to the Legislature of 1918, coincident with a report by the Boston Transit Commission as to future subway development at Boston, concludes the commission's report.

NORTHERN WHITE CEDAR ASSOCIATION CONVENTION

Pole Production for 1916 Considered Good—Advertising and Insurance Also Discussed—J. C. Kirkpatrick of Escanaba, Mich., Elected President

The twenty-first annual meeting of the Northern White Cedar Association was held at Minneapolis, Minn., on Jan. 29 and 30. In his presidential address T. M. Partridge, Minneapolis, said one of the most important features of the association's work during the past year had been its co-operative advertising campaign. As a result of an expenditure of $5,000 in the leading technical and trade journals he said the secretary had received inquiries from all sections of the United States and Canada and from several foreign countries asking for further information about cedar poles. Later in the meeting the association voted to continue its publicity work along the lines adopted last year.

L. A. Furlong, Minneapolis, speaking for the association's pole committee, called attention to the fact that the year's shipment of 20-ft. poles closely approximated the average sales for the five preceding years. The shipments of 25-ft. and longer poles were 35,000 less than the average sales over the last five years. This is considered an excellent record in view of the fact that metals used in line construction have advanced so much in price within the last year, and this tended to curtail line construction. Mr. Furlong urged the members of the association to take these figures into consideration in providing stocks for the coming year in order that they could be able to furnish prompt deliveries on poles. W. L. Lafean, Chicago, reporting for the insurance committee, recommended that in the future each member should place all insurance with a single company through one agent. This was considered better than the plan which has been followed in the past, because it is believed that less difficulty in settling claims will result.

The election of officers resulted as follows: President, J. C. Kirkpatrick, Escanaba, Mich.; vice-president, J. E. Gerich, Milwaukee, Wis.; treasurer, W. B. Thomas, Manistique, Mich.; secretary, N. E. Boucher, Minneapolis.

RELATION OF PUBLIC UTILITIES TO THE PUBLIC

W. W. Freeman Pleads for Sympathetic Co-operation on the Part of the Public and for Rewarding Efficient Operation by Higher Returns

At a meeting of the American Institute of Electrical Engineers held in Chicago on Jan. 31, W. F. Freeman, president of the Union Gas & Electric Company and chairman of the public policy committee of the N. E. L. A., read a paper on the "Relation of Public Utilities to the Public," the features of which are given in abstract below:

"It is comparatively easy to define the proper relation of public utilities to the public, but very difficult, under present conditions, to produce such relationship in actual practice.

"The primary excuse for the public utility is the need of the public for the service which the utility is created to render. If such service is rendered efficiently and honestly, the utility is a distinct benefit to the public and is entitled to be recognized as such. The chief obligation on the part of the utility is that the service shall be first-class and the rates reasonable, and, on the part of the public, that these conditions being met, no restrictions shall be imposed which make it impossible or difficult for the utility to perform its proper functions.

"Upon this outline of axiomatic principles, there is probably little disagreement in any quarter. The difficulty arises principally in the fact that partisans on both sides claim that the opposing side is unwilling intelligently and impartially to ascertain the facts governing the cost and character of the service, and to be bound by them." Mr. Freeman said "he thoroughly believes that the public utilities generally are keenly alive to their full measure of responsibility to the public and are anxious to have the public know this and have true and full knowledge of all of the facts which bear upon their proper relations. He believes also that a majority of the public are equally sincere in a desire to acquaint themselves with the facts and deal fairly with the public utilties according to their idea of justice.

"The secret to the securing of public support for public utilities consists in arousing the enlightened self-interest of the public to a realization of the fact that only a prosperous public utility can serve the public satisfactorily and acceptably. A financially impoverished utility cannot serve the public acceptably any more than an unnourished servant can do good work for his employer. Starvation wages never produced a good output for any employer, and it is as invariably true that a public utility, living from hand to mouth, is unable to give first-class service to the public. This matter goes deeper than the mere question of wages and food. Every thoughtful person realizes that an employer who is constantly criticizing his men without just cause, or who permits others to do so, is thereby reducing the efficiency of their work and injuring his own interests. Correspondingly, a public utility which is subjected continually to criticism and abuse from thoughtless or malicious elements in the community is thereby prevented from rendering to the public as loyal and efficient service as it could otherwise do."

The speaker then outlined certain conditions which ought to be guaranteed to public utilities by the public which they serve, in order that the service shall be adequate and satisfactory at all times. Prefacing these conditions, he repeated that the public utility is bound initially to the twofold obligation of good service and reasonable rates. These should be demanded by the public as the consideration for the right to serve the public.

"The first of these conditions is the protection by the public of the bonafide investment of the utility. This can only be done by earnings sufficient to insure the stability of the property, which must include an adequate rate of return to the investors, so as to induce new capital, as required from time to time for the expansion of the business in the public interest. As to the reasonable rate of return, neither the company nor the public can assume to determine the same as against the investor who must furnish the capital. If public utilities are restricted to rates of return which are unsatisfactory to investors, the inevitable result will be to curtail further investments in utilities, which will mean denial of extended service and impairment of the present service to the public.

"There has been a tendency in past years arbitrarily to determine certain fixed percentages as representing the allowable fair rate of return for public utilities; these percentages in some instances being as low as 6 per cent per annum, more often 7, 7.5 or 8 per cent, and in some particular cases as high as 9 or 10 per cent. It must be recognized that unless the rate of return allowed to public utilities is comparable to the returns allowed in other lines of business, where the risk is no greater, that the inevitable result must be disastrous to the public." The speaker said that if the public interest is to be best served the attitude of regulatory bodies in this respect must be liberalized in the future.

"Another very desirable condition is to furnish the public utility with sufficient incentive to unusual efficiency, to insure the highest grade of service at all times. This can only be done effectively through a proper sharing of the advantages of such unusual efficiency between the company and the public. An absolute limitation as to net earnings, irrespective of the efficiency of the service rendered, can never result in the highest degree of efficiency. Human nature does not permit 100 per cent efficiency at all times without some selfish inducements being offered. In other words, there must be a stake if the company is to be expected to play the game at high pressure. Regulation of prices, based solely upon definite rates of return, tend to carelessness as to expenses since the company has nothing particularly to gain by reducing its expenses after the net revenue is equal to the allowable rate of return. The public would be better served in such a case if efficiency were stimulated by a division of results. Maximum efficiency is what the public should seek and the necessary and reasonable compensation for same should be promptly forthcoming.

"The advantages to all of the application of these primary principles to the improvement of our public relations seem so obvious that it appears strange, indeed, that there should be any hesitation at all about their recognition and general adoption."

GENERAL GOETHALS ENGAGES IN PRIVATE PRACTICE

Opens an Office in New York City for General Consulting Practice in Civil, Mechanical, Electrical and Hydraulic Engineering

Gen. George W. Goethals, recently chief engineer of the Panama Canal and Governor of the Canal Zone, has announced the opening of consulting engineering offices in the Wall Street Exchange Building, 43 Exchange Place, New York City. General Goethals has associated with him experienced specialists, including George M. Wells, former resident engineer in charge of building construction, Canal Zone, and will engage in a general consulting practice in civil, electrical, mechanical and hydraulic engineering. Special attention will be given to examinations and reports on canals, harbors, dry docks, terminals, dams, water-power developments, water supply, purification of tropical waters, refrigeration, reinforced concrete structures, organization, management and public utility work.

TELEPHONE SITUATION IN NEW YORK'S CITY DEPARTMENTS

Analysis Made to Determine Whether or Not the City Is Receiving Adequate Duct Space for Its Municipal Circuits

A comprehensive analysis of the entire telephone situation in all the departments of the city of New York was recently made by Putnam A. Bates, as electrical engineer for a special telephone and subway committee appointed by the city Comptroller and Mayor. The three following subjects were the basis of the analysis: (1) The classes of service supplied and the business relation of the New York Telephone Company with the city. (2) The value of the complete service in comparison to the total amount paid annually to the telephone company by the city. (3) Whether or not the city is receiving from the telephone company and the subway companies adequate duct space in the subways for the proper installation of its fire, police and other departmental wires and cables.

The opinion of the committee in answer to the first question was summed up briefly by saying (1) that the classes of telephone service supplied at present vary to a considerable degree; (2) that the business relations of the telephone company with the city are not as concrete as they should be, and (3) that the magnitude of the city's telephone business, if it could be provided for in its contract, would justify an increase from 25 per cent to 50 per cent in the discount allowed.

In answer to the second question, the committee stated that, after full data of requirements and terms have been accumulated, the evidence will be conclusive for the installation of a control switchboard in charge of the Mayor's department or the borough president. While it has been suggested that it might be more expedient to begin with those departments entering the combination voluntarily and trust to attracting the others by demonstrated success, there is really no feature of this centralized switchboard problem that does not permit of being successfully worked out. It was recommended that in the Municipal Building as well as in other important buildings of the city where extensive telephone service is employed, that the switchboard plan be promptly adopted.

Regarding subways, the committee is of the opinion that it would be highly desirable for the city to exercise its privilege of recapture of these subways, as the large gross rentals with the slight attendant cost of operation and maintenance would add greatly to the city's revenue, and pending a permanent or satisfactory adjustment of the entire matter, and provided that the city may require the subway companies to build such subways as the city may need without cost to the city. This construction work is to be supervised by the city so that the true cost may be determined during the process of construction. From this it is believed that the most comprehensive subway system for both departmental and commercial interests will result by following out the procedure already taken by the fire department, when it adopted the course of requiring that the subway companies provide all the subway construction necessary for the laying underground of the departmental cables.

NEW YORK STATE MOTOR VEHICLE TAX INCREASED

Flat Rate of $5 a Year Raised to $15 to $70 a Year, Depending Upon the Capacity of the Machine—Owners Protest

The New York State Senate on Tuesday passed the bill raising the State license fee on all motor trucks and automobile buses from a flat rate of $5 a year to a measured rate having a minimum of $15 and running to $70, dependent upon the capacity of the truck.

The bill was designed to produce additional revenue for the State. It has been variously estimated that the increased revenue will be between $500,000 and $650,000 annually.

There was a hearing before Governor Whitman on Feb. 6 on the recently passed Hewitt bill, which provides for the payment of increased, graduated registration fees by the owners of auto buses and commercial motor trucks. The Governor informed the automobile men that he was in favor of their proposal to have a new commission study the situation with a view to remedying any injustices which the new tax law might inflict.

The contention of the truck owners is that the law was rushed through both houses of the Legislature, giving them no chance to be heard. The commission appointed last year was authorized to fix fees for auto trucks only. It sent to the Legislature at the opening of the session a schedule, which the automobile men say they did not have an opportunity to study.

Senator Brown, majority leader, admitted later he would agree to the introduction of amendments changing certain minor features of the bill. The Governor at the close of the hearing informed Charles G. Bond, counsel for the Motor Truck Club, that he favored the proposal of the club for another commission to put the tax on a more scientific basis, but that will bring no relief to the truck owners this year.

WATER POWER LEGISLATION

Congressional Action Subject to the Whims of Senators Who Seem Disinclined to Bestir Themselves

As the result of opposition in the Senate, principally on the part of Senator Fall of New Mexico, there has been but little consideration in that body of the bill to provide for the development of water power and the use of public lands in relation thereto.

Senator Walsh of Montana, who has the bill in charge, has forced the measure before the Senate once or twice at afternoon and night sessions, but no progress was made. Senator Townsend of Michigan has also objected to consideration of the bill, because, he said, he believes "the bill is simply being used as a buffer to prevent the consideration of other legislation, and I do not care to sit quietly by and allow that to be done if it can possibly be prevented."

One of the most serious stumbling blocks in the way of the bill has been presented by Senator Fall, who has announced that he will vote against the measure, "with or without discussion," an attitude that will have its effect on other Senators because of the state Senator Fall comes from and the presumable interest of that State in the measure.

The curious fact has developed that Senator Fall's objection, or at least one of them, to the bill, is that two years ago, during the consideration in committee of a bill concerning public lands and radium, while he was a member of the committee, he endeavored to obtain from Senator Walsh permission to go to New York to attend to some business, and, he said, Senator Walsh informed him he could not be spared. This personal feeling brought about an interesting colloquy in the Senate between the two legislators during which much feeling was shown, and it served to indicate that Senator Fall is an avowed enemy of the bill, an important fact when it is considered that by reason of the Senatorial courtesy which prevails in the Senate in the absence of set rules any one Senator can block any legislative program.

ACTION BY UNITED STATES CHAMBER OF COMMERCE

Revenue Bill Criticised, Federal Trade Commission Commended, Daylight Saving Indorsed and New Work Found for Department of Commerce

Several important resolutions were passed by the Chamber of Commerce of the United States at its convention held in Washington last week, of concern to the business interests of the country. One of the most important of these was to voice the sentiment of the business men in every State in the Union of "profound appreciation of the gravity of the international relations which now confront the country" and "solemnly pledging" the business men "to stand as one behind the President in patriotic purpose whatever the eventuality."

The Chamber reaffirmed its devotion to the program of increased military preparedness, and pledged its support to any just and reasonable measures of taxation which the government may see fit to adopt, "but," the resolution read, "it feels compelled to protest against the inequitable and discriminatory methods of taxation proposed in the bill now in the House of Representatives providing for a tax on excess profits of corporations and co-partnerships." The Chamber urged that any bill passed by Congress to raise taxes should accomplish these purposes "along lines of fairness to all interests of the country so that all citizens should pay their just share of the tax."

The Chamber commended the Federal Trade Commission "as expressed by its action in freely conferring with business as represented in trade associations and assisting by constructive suggestion in guiding it along lines consistent with progress, existing law, and the public welfare."

"Daylight saving" was indorsed and legislation recommended by Congress. The Chamber reaffirmed the proposals which have been made for budgetary procedure in national affairs, alluding to the fact that the appropriations before the present Congress, when it opened, amounted to $1,600,000,000. The Chamber urged the creation for a period of not less than five years of a salaried commission to be appointed by the President of the United States to consist of trained economists and statisticians as a central agency through which the statistical activities of the Government, such as the Census Bureau, may be correlated.

The committee on the Department of Commerce proposed certain new departmental activities as follows:

First, the department should find out what it costs to do business in the United States. As the department found out enough such facts to proceed with, it should, as its second new function, deduce from them sets of reasonably attainable standards, for the various items of expense in the various lines of business. The third new function would be to tell the manufacturer and business man, that is, to circulate information concerning the methods of the more efficient. The fourth new function would be the working out of still better methods than the department found in use in any actual business.

Fortification Appropriations. — The Sherley bill making appropriations for fortifications and other works of defense carries appropriations aggregating $61,000,000, an increase of $22,000,000 over the amount appropriated for the fiscal year 1916-1917. Among the principal increases carried in the bill are the following: Electric light and power plants at seacoast fortifications, $110,000 and searchlights for important harbors, $25,000.

Barstow Management Association Formed.—The W. S. Barstow Management Association has been incorporated for the purpose of supervising the management of the subsidiary properties of the Eastern Power & Light Corporation and the General Gas & Electric Company. W. S. Barstow & Company, Inc., which has heretofore supervised the management of the subsidiary properties will continue in general executive charge and also control their financial operations.

New Large Holding Company.—A new holding company to be known as the National Utilities Company has been incorporated with a capital of $10,000,000 to take over the National Properties Company, the National Gas, Electric Light & Power Company and the Jersey Central Traction Company. These subsidiaries serve about fifty municipalities with net gross earnings for the past year of $9,327,700. Van Horn Ely, president of the National Properties Company, will be president of the new company.

Improvements Being Sought in Methods of Generating Electricity by Wind Power.—Experiments are being conducted by the electrical engineering department of the State Agricultural College at Manhattan, Kan., seeking improvements in the method of generating electricity from windmill power. In the present tests, the generator is mounted on the head of the mill, and geared direct, instead of being belted to the mill at its foot, as in the previous tests. The necessity seems to be for mills that require lower wind velocities to start them than mills now available, since there is too much idle time for mills, and too large a necessity for batteries and storage during running time.

Increased Powers for New Jersey Utility Board.—To avoid the necessity for opening up improved thoroughfares a bill has been introduced in the New Jersey Legislature providing jurisdiction over the installation of conduit lines, gas, sewer and water pipes by the Board of Public Utility Commissioners. The measure authorizes the board to order the installation of such improvements before a street is permanently improved in cases where there are not sufficient consumers along the thoroughfare to make the investment profitable at the time. In this, however, the board must be assured of reasonable interest charges upon the investment which the particular company must make until such time as new property owners render a profitable investment.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

College Gives Electrical Course for Women.—A course, it is understood, will be given at the University of California in household electricity for women. Attention will be given to the manufacture, repair and use of the electrical household conveniences and will include, besides demonstrations, practice in repairing appliances. The course, it is thought, will be given both in San Francisco and Oakland.

Homestead Entry on Water Power Sites.—The Sinnott bill was reported by the House committee on public lands on Feb. 1 providing for a homestead entry on water power sites. The bill would allow the Secretary of the Interior to permit entry on public lands reserved for power sites where location will not materially injure such lands. Entrymen would be permitted to locate subject to the right of the United States and its lessees to use the lands for the purposes for which reserved.

Reserve Power Insurance.—Plans for the immediate future contemplate, where feasible, the connection of properties operated by W. S. Barstow Management Association by transmission lines so that each of the systems so connected will have the benefit of the reserve power of the others. In the event of breakdown or overload at any particular point the reserve power of other connected plants will be used to take care of the emergency. By this plan, it is felt, maximum efficiency in the generation can be secured, as the load can be so shifted as to permit the most economical plants to be kept in continuous operation. Furthermore, it is expected that operating costs will be lower.

Worcester Lighting Rates to Be Reduced.—Rates for residential lighting in Worcester, Mass., will be reduced from 9 cents to 8 cents per kilowatt-hour on all bills rendered on and after April 1, it was recently announced by the Worcester Electric Light Company. This is the annual reduction made by the company which alternates yearly on the residential and commercial basis, and the 8-cent rate will make the two rates the same for 1917, which will be the lowest in the history of the company. The last reduction made in residential lighting was in January, 1915, when the rate was made 9 cents instead of 10. In 1914 the price on residential lighting was reduced from 11 cents to 10, at which time commercial lighting was reduced from 10 cents to 9. Last year the commercial rate was made 8 cents. Every year for the past five or more the company has made a reduction in its rates, and it plans to continue as long as business keeps on increasing.

"Pacific Service" Pay-roll.—The Pacific Gas & Electric Company of San Francisco has a list of employees totaling 5000, for which the annual payroll amounts to $5,250,000, or an average of $87.50 per month per employee.

Toledo Floodlights McKinley Statue.—Influenced by the successful floodlighting of the Statue of Liberty in New York harbor, and through the efforts of the Toledo Railways & Light Company, the McKinley monument in Courthouse Park, Toledo, will be similarly illuminated. The lighting was effected by erecting searchlights on the curb, arc lamps opposite the statue and entailed no line wires.

Minneapolis Sets Up New House-Wiring Record.—During the year 1916 a new high record was established in Minneapolis in the number of electrical wiring permits and the cost of work covered by them. Compared with 1914 and 1915 the figures are as follows:

	Number of Permits	Estimated Costs
1914	8,439	$991,755
1915	9,827	888,950
1916	11,858	1,570,365

These figures include the wiring of new houses as well as of those already built, and the estimated costs include cost of fixtures and glassware as well as the cost of wiring.

Bill to Permit Purchase of Utilities by Cities Without Use of Municipal Bonds.—A bill has been introduced in the house of the Indiana Assembly authorizing cities and towns to buy any public utility without using municipal bonds therefor and permitting any bonds issued in payment for the property to be secured by mortgage on the utility purchased. Under this bill any obligation incurred by a city or two will not be considered a debt within the meaning of the constitution. While the measure is intended to meet a local situation, it is broad enough to cover every city and town in the state which may desire to buy and operate public utilities.

Bill to Regulate Utility Employment Contracts.—A new Public Service contracts law, to be Chapter 69 of the Consolidated Laws, regulating contracts of employment between public utilities' corporations and their employees has been introduced in the New York Assembly as Bill No. 310. After Sept. 1, 1917, all employment must be by contract after a reasonable term of trial not exceeding six months, the contract to be for not less than one or more than three years, during which time the corporation may not discharge the employee nor may he withdraw from service of corporation except under certain conditions. The Public Service Commission is to approve the form of contract. For adjudicating claims arising under contracts, there is to be created by a joint action of corporations and employees a board of award of not less than three nor more than nine members, one member to be appointed by the Public Service Commission and others in equal number by the company and its employees. Strikes are prohibited.

The Engineer and Organization.—A regular meeting of the New York Section of the American Society of Mechanical Engineers will be held at the Engineering Societies Building on Feb. 13. President Ira N. Hollis will make an address on "The Engineer and Organization."

Kansas City Rejuvenation.—The Kansas City Jovian League held its first rejuvenation of 1917 under the direction of First Tribune J. D. Todd and Second Tribune J. F. Bratney, at the Coates House the evening of Jan. 26. The speaker was the Rev. W. S. Abernathy, who talked on the necessity of a high mark for individual aspiration, fidelity to duty and opportunity.

Future Meetings of Institute Sections.—The following future meetings of sections of the American Institute of Electrical Engineers have been announced: Boston—March 6. Subject: "Electric Transmission for Motor Cars"; speaker W. B. Potter. Chicago—February 26. Subject: "The Making of Rates after Valuation." Fort Wayne—March 8. Motion picture entitled "King of the Rails" showing evolution of transportation. Spokane—February 16. Subject: "Transmission and Distribution." March 15. Subject: "Utilization of Electricity."

New York Electrical Society to Attend Aeronautic Exposition.—By courtesy of the International Exposition Company, the 353rd meeting of the society will be held at the Pan-American Aeronautic Exposition, at the Grand Central Palace, New York City, on Feb. 14. Before the visitors make an inspection of the exhibits a brief address will be given by Augustus Post, of the Aero Club of America, explaining the features of some of the leading types of flying machines; and at the same time illustrations of these will be thrown on the screen, and moving pictures will illustrate the part that aircraft is playing in modern war.

Future Institute Meetings.—The March meeting of the American Institute of Electrical Engineers will be held in Chicago, Ill., on March 9, under the auspices of the Chicago section and the committee on protective devices. The official headquarters of the institute during this meeting will be at the Hotel Sherman, where the technical sessions and committee meetings will be held. The subject of the meeting will be "Relay Practice." Two papers will be presented on this subject, one by Philip Torchio and the other by R. F. Schuchardt. The April meeting of the Institute will be held in Schenectady, N. Y., on April 13. The program for this meeting has not yet been completed. The annual business meeting of the institute will be held in New York at the Engineering Societies Building, on May 18. At this meeting the report of the board of directors is presented and announcement made of the election of officers for the ensuing year. The annual convention will be held at Hot Springs, Va., during the week beginning June 25. The headquarters of the institute during the convention will be the Homestead Hotel.

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

Lynn Electrical Engineers Banquet.—The annual banquet of the Lynn section of the American Institute of Electrical Engineers was held at the Boston City Club on Feb. 3.

Institute of Radio Engineers.—At a meeting held on Feb. 7, in New York City, Julian Barth presented a paper on "The Influence of Commercial Conditions on Transmitter Construction."

St. Louis Jovians Hear Advertising Talk.—That co-operative advertising campaigns are producing great results in developing the electrical field was outlined before the St. Louis Jovian League at its luncheon meeting Jan. 30 by P. L. Thomson, advertising manager, Western Electric Company.

Lincoln Meeting for Cleveland League.—Dr. G. C. Ashmun, a former member of a company of cavalry that served as a body-guard and escort to President Lincoln from December, 1863, to the time of his death in April, 1865, gave the members of the Electrical League of Cleveland recollections of his services in 1863, 1864 and 1865 at the Lincoln meeting held on Feb. 8. Dr. Ashmun was for some years president of the Board of Education of Cleveland. In addition to this program, there was special patriotic music.

New York City Jobbers Meet.—A meeting of the Metropolitan Electrical Jobbers' Association was held in New York City on Jan. 17. Dinner was followed by an address by President C. P. La Shelle, during the course of which he congratulated the association on the splendid work it had accomplished for many jobbers in the Metropolitan zone, calling attention to the fact that this was possible only because of the loyal co-operation on the part of all members. William G. Campbell, general Eastern sales manager for the Safety Armorite Conduit Company, delivered an address in which he stated that in event of cessation of hostilities in Europe he could hardly see where the electrical business would feel an immediate depression, as manufacturers of structural steel and accessories had on hand such a large volume of domestic orders that it would require nearly one year to complete orders for which bona fide domestic deliveries were specified. William A. Neefus of the Kirk Fuse Company spoke on "Fuses and Their Use in Electrical Constructure." The meeting concluded with an informal talk by Arthur F. Stanley, who has been called the dean of the New York retail business, having continuously been identified with the electrical industry in New York since the early 70's.

National Fire Protective Association.—Open meetings of the electrical committee will be held at the New York Board of Fire Underwriters' headquarters on March 28 and 29.

Divisional Meetings of Supply Jobbers.—The Atlantic and Central Divisions of the Electric Supply Jobbers' Association will hold their regular quarterly meetings some time in March. The exact place and dates have not as yet been announced.

New York Jovian Meeting.—A regular monthly luncheon meeting of the New York Jovian League was held on Feb. 7. Following a short business section W. F. Schmidt delivered a moving picture lecture entitled "Speeding the Spoken Word." The film depicted the present art of telephone engineering, maintenance and operation.

New York Section, I.E.S.—A. H. Rudd, signal engineer, Pennsylvania Railroad Company, read a paper entitled "Position—Light Signals for Railroad Service" before the section on Feb. 8. At an informal after-meeting John W. Dudley of the Lee Lash Studios spoke on "Some Studio Problems which Face the Motion Picture Producer." This address was supplemented by an exhibition of colored fabrics by Thomas Scofield, showing how stage effects may be spoiled by the lighting man. The evening concluded with some specially arranged entertainment features.

Princeton Engineering Association in Movement to Encourage Engineering Studies.—A movement to stimulate the further development of engineering studies at Princeton University was launched by the Princeton Engineering Association at the New York-Princeton Club on Feb. 6, at a testimonial dinner to Dr. L. D. Ricketts, president of the American Institute of Mining Engineers and a Princeton graduate of 1881. Addresses were made by Dr. Ricketts, President John Grier Hibben, of Princeton University, and Dr. Charles Mann, of the Carnegie Foundation, author of a report on engineering education, soon to be made public by the Foundation. At present more than 900 of Princeton's 8000 graduates are engaged in some form of engineering activity.

Michigan Engineers Meet.—The thirty-eighth annual convention of the Michigan Engineering Society was brought to a close on Jan. 18. Topics of interest to engineers in general besides particular branches of engineering were discussed. F. N. Menefer presented a paper on the "Sixty-Foot Hydroelectric Development on the Chippewa River Now Under Construction," and A. Streiff of Jackson gave an illustrated lecture on "Modern Spillways." Of further interest to the electrical engineer were two papers, one by R. D. Goodrich on "Licensing of Engineers" in which he advocated the registration of engineers and told of laws which have been passed in other States on this subject, and the other paper by T. O. Williams on "The Value of a State Administration to Deal with Engineering Works."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public-utility companies.

Reasonable Care in Stringing Guy Wires.—The Appellate Court of Indiana (114 NE 227) has held that if a telephone company secures poles along a highway, which it has right to occupy for this purpose, with guy wires, it must use reasonable care not to endanger public travel or the safety of individuals in the reasonable and ordinary use of the highway.

Workmen's Compensation.—An insurance carrier, as assignee of cause of action of widow of deceased, who was killed by electrocution from defendant's wires, was held by the Appellate Division of the Supreme Court of New York in Casualty Company of America versus A. L. Swett Electric Light Company (162 NYS 106) entitled to recover full liability of defendant and not confined to payment actually made to widow.

Degree of Care That Should be Exercised by Public.—That a person is entitled to be judged in view of the knowledge generally possessed by the community was held by the Supreme Court of Pennsylvania in the case of Smith versus Harwood Electric Company (99 A 473). The husband of the plaintiff in this case lost his life by electrocution from stepping on an iron sewer plate on which had fallen a broken electric light wire. Although warned that the wire was down, there was no evidence to show that the man knew that the iron plate was charged and the court, therefore, held the presumption to the contrary, since, it stated, men are presumed to be governed by the natural instinct which leads them to avoid danger rather than court it.

Right Denied to Sell Energy to Company in Non-Adjacent Territory.—An interesting case involving charter validity has recently been decided by the Supreme Court of Pennsylvania in Citizens' Electric Illuminating Company versus Lackawanna & Wyoming Valley Power Company (99 A 462). The defendant company contracted to supply energy to the Jenkins Electric Light, Heat & Power Company, which lies within the same territory as the plaintiff, but has no generating plant of its own. Since the Lackawanna and Jenkins companies occupied non-adjacent territory, the court held that the defendant was not under law authorized to sell energy to the Jenkins company, because the act authorizing contracts between companies applied only when both of them are authorized to supply the territory in question. Although the franchise of the Citizens company was not exclusive for the territory served, it has such an interest that the court held that it maintain a bill to enjoin the defendant's compliance with the contract.

Public Utility Regulation.—The Supreme Court of Illinois held in (114 N E 324) that the Illinois Commission cannot, where rates filed with it are attacked, require a public utility to charge a lower rate pending its determination whether the rates attacked are unjust and unreasonable. Where rates of a public utility are attacked as unjust the utility has the burden of showing that the rates are reasonable.

Highest Degree of Care Must be Maintained by Lighting Company.—The law exacts from those who avail themselves of the use of electricity in the prosecution of industry, the highest degree of care to prevent injury of others, it was held by the Supreme Court of Missouri (189 SW 816) in the case of Myers versus the city of Independence. Myers, a lineman, was working on a dead line which was suddenly charged with a deadly current and he was injured to the extent of losing a portion of one hand and one rib, and suffered other internal injuries. The court held that since the plaintiff was a young man of twenty-three, earning $2.80 per day, and had been injured to this extent, a verdict of $16,000 was not too excessive as to indicate passion or prejudice in the minds of the jury.

Workmen's Compensation to Partial Dependents.—A boy of seventeen, in previous good health, dropped dead at the moment of contact with an electric wire or the socket attached to it. He was working on a wet cement floor It was held by the Supreme Court of Minnesota (159 N. W. 755) this evidence sustains a finding that deceased died an accidental and not a natural death. Decease earned $7.50 a week. He gave it all to his parents, and lived with them, receiving his lodging, board and clothing. His father earned $18 a week. There was no other family income. This evidence is sufficient to sustain a finding that the parents regularly derived part of their support from and were partially dependent upon deceased.

General and Special Rates Distinguished.—The Birmingham Railway & Light Company made a ten-year contract with a customer providing that if it should reduce the general rates for light in the city, the rates in the contract should be reduced in proportion to such reduction. Subsequent reductions were made, and the rate charged the customer accordingly reduced, but it contended for a still lower rate on the ground that because a few of the larger business concerns in the city received a special rate in consideration of agreeing to use a specified quantity of electric energy within a stipulated period for a certain term of years, such reduction to them constituted a reduction in the general rates in the city to the amount named as a special rate to the particular contract users. The Court of Appeals of Alabama held (73 S 215) that such was not the case, since "general" and "special" are antonyms, "general" meaning, pertaining to the majority, common to the greatest number, while "special" means pertaining to one or more individuals as distinguished from the class to which they belong.

Commission Rulings

Important Decisions of Various State Bodies Involving or Affecting Electric Light and Power Utility Operation and Practice.

Illinois Commission Report Published.—The opinions and orders of the State Public Utilities Commission for the fiscal period Dec. 1, 1914, to Dec. 1, 1915, have been printed and are ready for distribution upon application to the commission's secretary, R. V. Prather, Springfield, Ill. The volume has been edited and the orders have been digested and summarized by Attorney John Lewson of Springfield, Ill., formerly associate editor of the Illinois Notes, Supreme Court Reports.

Illinois & Utilities to Change Date of Annual Report.—The State Public Utilities Commission has permitted the utilities of the State to change the date of the annual report from a termination on June 30 to a termination on Dec. 31. The fiscal period covered by the utilities' report is now coincident with the calendar year and conforms to the dates upon which the majority of utilities close their books of account. The order is in line with a recent order of the Interstate Commerce Commission regarding railroad reports.

Company Not Obligated to Disconnect Service in Summer Without Notification.—The Springfield Board of Education having been assessed with a service charge against various schools during the summer months of 1915, by the Springfield Gas & Electric Company, protested to the Missouri Public Service Commission against these charges, pointing out that the schools were closed during the summer months and that such was public knowledge. The rates which the city was paying for service to its schools were based upon an annual charge. In view of this fact, the commission stated that, "if the utility each year places the customer on the schedule offering the greatest advantage based on his annual requirements, it is doubtful if any part of the charges should be remitted unless the circumstance is such as to relieve the utility of the equivalent expense. This does not seem to be the case in the matter at issue. The service charge is supposed to compensate the utility for certain investment and standby charges. By disconnecting for a short period of non-use, the company cannot remove and make use of the equipment involved, unless an appropriate charge for removing and reinstalling is made. The conclusion of this commission, therefore, is that the utility is not obligated to disconnect the service or remit the service charges for the customer during the season of no use or small use without notification from the consumer. In the instant case, the proper charge is the charge computed for each month under the rate legally effective at that time."

W. D. RAY

Men of the Industry

Changes in Personnel and Position— Biographical Notes

W. D. Ray, for the last two years vice-president and general manager of the Pennsylvania Utilities Company of Easton, Pa., which was recently sold by the Barstow interests, has tendered his resignation effective April 1. Prior to coming to Easton, Mr. Ray was for four years vice-president and general manager of the Northern Indiana Gas & Electric properties operating in Hammond, Michigan City and other Indiana cities, and before that he served three years as commercial agent for the Sanitary District of Chicago. Mr. Ray's early years were spent as electrical engineer for several railroads in the Chicago territory, and later he became designing engineer for the old Standard Electric Company. During the Chicago World's Fair, Mr. Ray was connected with the exposition's electrical department. At this period he collaborated with C. K. MacFadden in the book "The Practical Application of Dynamo-Electric Machinery," a little volume which has appeared in many reprintings. From 1894 to 1897 he was superintendent of the Everett, Wash., electric railway, returning to Chicago to handle electric-motor sales for the Lorain Steel Company. Later Mr. Ray had charge of the complete construction of two 75-mile electric railways in Michigan, and of the Grand-Rapids-Muskegon third-rail road. During the two years, Mr. Ray has been in charge of the Pennsylvania Utilities Company, which furnishes electricity, gas, and electric railway service to a community of 100,000 people in Easton and neighboring towns, considerable rehabilitation work has been accomplished, and through Mr. Ray's personality and executive grasp public confidence and good-will have been regained in the face of difficult operating problems.

Harry G. Louser has resigned his position as superintendent of the Edison Electric Illuminating Company of Lebanon, Pa., to devote his time to private interests.

J. Henry Russell has been elected president of the Cambridge (Mass.) Electric Light Company, to succeed the late Joseph Q. Bennett. Gustavus Goepper was appointed to succeed Mr. Russell as vice-president.

J. J. Molyneaux has been appointed auditor for the Southwestern utility properties of H. M. Byllesby & Company.

A. W. Lee of the Louisville Gas & Electric Company has been elected vice-president of the Louisville (Ky.) Engineers' and Architects' Club.

A. E. Ward of Reading, Pa., has been appointed superintendent of the Reading Transit & Light Company at Lebanon, Pa., succeeding Harry G. Louser, who has resigned, as noted on this page, to devote his time to personal interests.

J. V. Guilfoyle, chairman of the merchandising committee of the N. E. L. A., who has been manager of the appliance bureau of the United Electric Light & Power Company, New York City, is now associated with the Western Electric Company at its New York office as sales specialist.

George Estill has been appointed chief engineer of the group of electric light and power companies controlled by the Cumberland County Power & Light Company, of Portland, Me. Heretofore Mr. Estill has been chief engineer of the Cumberland County lines and of the York County Company's property. Under the new appointment he also will take charge of the Lewiston, Augusta and Waterville system and the Westbrook Electric Company.

E. B. Merriam has become head of the industrial service department of the General Electric Company, resigning his position as assistant engineer of the switchboard department to take the new position. The industrial division was recently organized to supervise the education, employment and provision of opportunities for advancement of employees at the Schenectady plant of the company. Mr. Merriam has been connected with the company for sixteen years, serving in its commercial, manufacturing, engineering, development and research departments.

John J. Carty, chief engineer of the American Telegraph & Telephone Company has been commissioned by President Wilson as a major in the Signal Officers' Reserve Corps. A statement issued by the War Department says: "The appointment of Major Carty in the Army Reserve Corps is a notable example of the value of that corps in making available to the government the services of the best talent of the country in time of national crisis." For his services in the advance of science Mr. Carty was recently also decorated with the orders of the Rising Sun and the Sacred Treasure by the Emperor of Japan.

P. H. HONOLD

P. H. Honold, the president-elect of the Electrical Contractors' Association of Wisconsin, is treasurer of the C. A. Honold Company, general contractors, Sheboygan, Wis. Mr. Honold was for four years engaged in construction work with the Sheboygan Light, Power & Railway Company and later became an erecting engineer for the Allis-Chalmers Company of Milwaukee. After experience in electrical construction work at Gary, Ind., he was for six years with W. A. Day & Company, Chicago, as general superintendent of construction, resigning to become treasurer of the Honold company at Sheboygan.

W. A. Holland, Jr., after eleven years with the General Electric Company, at Schenectady, principally in the switchboard engineering department, has resigned to take up the teaching of electrical engineering in Mackenzie College, Sao Paulo, Brazil.

D. W. Blakeslee has resigned his position in the engineering department of the Duquesne Light Company, Pittsburgh, Pa., to become electrical engineer and assistant superintendent of the Penn Electrical & Manufacturing Company, Irwin, Pa., manufacturers of switches and switchboards.

S. W. Tracy has been elected president of the Chicago Utilities Company and its three subsidiaries, the Chicago Tunnel Company, the Chicago Warehouse & Terminal Company and the Illinois Telephone & Telegraph Company. J. C. Payton has been appointed secretary of the Utilities company.

Obituary

George H. Hill, assistant engineer of the railway department of the General Electric Company, died at his home in Schenectady, N. Y., on Jan. 31. Mr. Hill was a graduate of Johns Hopkins University. More than forty patents in the electrical field had been granted to Mr. Hill, and he was the author of many articles on electric railway subjects in the technical press and the proceedings of the A. I. E. E., of which he was an active member.

REVIEW OF TRADE AND MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

LARGE STOCKS OF HEATING APPLIANCES ACCUMULATED

Urged by Salesmen, Central Stations and the Trade Recognize Opportunity to Take Advantage of Rising Market

There seem to be many good reasons for believing that during the month of January the trade and central stations stocked up well in flatirons and toasters in anticipation of the February increase in prices. The announcement came out late in December that prices would advance on Feb. 1, and, urged by factory salesmen, the trade was quick to take advantage of this increase. Dealers, central stations and jobbers recognized an opportunity to buy at lower prices and to gain the added profit on the rising market.

It is not known to what extent deliveries have been made on these January orders. In order to enjoy the former price, shipment according to the patent license agreement must have been made before Feb. 1. All goods shipped later must be billed at the Feb. 1 prices. It is thought in some quarters that because the buying was so heavy in January some manufacturers might find themselves unable to ship all the goods prior to Feb. 1. However, if these manufacturers had the foresight to anticipate this increase in prices, and had, as a result, laid in a sufficient supply of raw materials and had stocked up in appliances—and there is no reason to suppose that they did not—they would be able satisfactorily to cope with the increased demand.

PACIFIC COAST RETAIL CONDITIONS IMPROVE

Organization of Dealers and Contractors and Effective Co-operative Plans Produce Marked Results in Merchandising Field

Marked improvement has been noticed in the conditions under which the retailer of electrical goods and the electrical contractor conduct business on the Pacific Coast. The organization of contractors and dealers over practically the entire coast field has made it possible for this branch of the industry to put into effect helpful co-operative movements involving central stations, jobbers and even manufacturers.

Although slow deliveries is a factor which has influenced trade in practically every line, yet Pacific Coast retailers have been to a certain extent automatically protected on this score. Because of the distance from manufacturing centers as well as delays in securing shipments, Pacific Coast jobbers have carried larger stocks in all lines than they would under other conditions. This has enabled the retailer to fill orders promptly and even to work on smaller stock margins than usual, which has been particularly helpful in a time when prices have so materially advanced.

Another feature of the organization program which has been carried out on the Pacific Coast is that the individual retailer and contractor has gained valuable hints on business methods. A notable result of this has been increased attention to merchandising costs. The education along this line of a considerable proportion of men engaged in the industry has produced better feeling among the trade, has reduced competition of the harmful sort, and better business methods have materially improved the contractors' credit.

There are indications that the advance in range prices has acted to decrease the number of range sales, although the effect on socket appliances has not been nearly so noticeable. It has been noticed that the number of electrical retail stores in San Francisco has not increased for some time. One of the chief reasons for this, it is believed, is that the retailer needs more assistance. The central stations, it has been suggested, could well afford to co-operate by supplying energy for demonstration at a special rate of say 1 cent per kilowatt-hour. A special meter could be installed for this purpose and this privilege extended to department stores, electrical dealers, and, in fact, any firm in a position to sell socket devices.

There is a feeling on the coast that incandescent lamps are "the neglected opportunity" of the retailers' field, their relation to the trade being the same as that which flour and sugar bears to the grocers' business. With lamps bringing in 25 to 30 per cent profit without a special effort, it is felt that with a little attention this line can be depended upon to pay the rent and carry the retailer over slack times.

CONDITIONS IN LABOR MARKET BECOMING BETTER

With no New Contracts Forthcoming War Order Plants Are Closing Down, Making Considerable Skilled Labor Available for Other Work

Within the past two or three weeks the general conditions underlying the labor market in this country have undergone a decided change. The labor market is now much easier than it was at the beginning of the year. There is still a scarcity of first-class machine operators, but of a less intense nature. The situation is most notable in New England, where the shortage of labor was first felt. Munition manufacturing plants which were largely responsible for the abnormal labor conditions had been closing down one by one or curtailing operations largely, thereby throwing numbers of skilled workmen on the market. Many of these plants that sprung up like mushrooms during the war order "panic" of 1915 have completed or are fast completing their contracts and having no new business in sight are forced to shut down.

This condition has afforded a number of electrical manufacturers an opportunity long looked for. While labor was so scarce it was frequently necessary to employ very inefficient and unskilled labor to do the work of skilled labor at skilled labor wages. The result was not always entirely satisfactory. Many electrical manufacturers within the past few weeks have been able to strengthen their force of employees by adding some of these men who had been working on war orders and by letting go men who were unskilled or inefficient.

Provided no great manufacturing activity is stimulated by the impending war cloud, it can be confidently expected that the labor situation will quickly be cleared up, and that by spring there will be a sufficiency of labor to permit uncurtailed industrial operations.

In the unskilled labor market there is still a dearth in help, for which there is no relief in sight at present. The building operations and extensions and improvements which can no longer be held back, together with the number of men required for farm help, will present a rather serious problem to manufacturers, it is expected, as soon as the frost is out of the ground.

A summary of the labor conditions in the twelve reserve districts during the first three weeks of January, made by the Federal Reserve Board, shows the following: Boston, well employed; New York, continued high wages and full employment; Philadelphia, unsettled; Cleveland, some unrest; Richmond, fully employed at good wages; Atlanta, fair; Chicago, good; St. Louis, well employed, wages high; Minneapolis, labor fully employed; Kansas City, better than

normal for season; Dallas, labor fairly well employed; San Francisco, well employed with wages advancing. The outlook in the twelve districts is given as follows: Boston, moderately satisfactory; New York, conservative, but generally favorable; Philadelphia, apparently good, but possibility of peace has added uncertainty; Cleveland, promising; Richmond, encouraging; Atlanta, good; Chicago, good; St. Louis, encouraging; Minneapolis, good; Kansas City, promising; Dallas, unemployment among building trades; San Francisco, favorable.

LONG-PERIOD DELIVERIES FOR RAW MATERIALS CONTINUE

Manufacturers, However, Accept Conditions, Ordering Accordingly, Thereby Making for More Satisfactory Situation

No general change in the raw materials delivery situation is apparent, except perhaps a psychological one on the part of buyers. In some few cases an improvement has already been noted. Carbon products, it was stated by a manufacturer of dry batteries, are being delivered promptly and in sufficient quantities. The same is said to be true of the other raw products going into the manufacture of dry batteries.

In general, however, deliveries of raw materials are just as long as they were in the fall of 1917, and in many cases longer. Brass manufacturers, steel manufacturers, foundries, etc., have sufficient orders on their books to take care of capacity production for many months, and will therefore be unable to materially better deliveries for some time. The shortage of freight cars for the past three months has been another very disturbing factor in this connection. Some roads have been forced to place embargoes on heavy freight, thereby adding a further delay in shipment.

In view, however, of the chaotic state of deliveries of twelve months ago, it can almost be said that at the present time deliveries are in an excellent state. As buyers formerly had been accustomed to receiving delivery in at least three weeks or a month, they were naturally disturbed when deliveries had to run into months and months. Factories were sending orders for rush delivery and making every effort to replenish and maintain their stock. When, however, buyers had reached that psychological state that they finally were satisfied that deliveries could not be made in as short a time as formerly, they accepted the situation as such, and made their plans accordingly. As a consequence, even though the deliveries are two, three, four, and sometimes more, times longer than prior to the war, there is very little suffering compared with what there was ten months ago. Contracts are being placed now for three-months' delivery with little more feeling in the matter than when they were placed for three weeks.

It took some time for manufacturers to adjust themselves to these conditions, but it is felt a favorable result has now been achieved. Buyers of finished products, however, have been slower in accepting these conditions, but now are rapidly coming to share their manufacturer's point of view.

ELECTRIC FAN STANDARDIZATION

Over 90 Per Cent of 1917 Output to Be Sold with Cord and Plug—Proposed Testing for Standards Will Probably Be Generally Used in 1918

Until quite recently there was little evidence of cooperation on the part of manufacturers of electric fans for the purpose of standardizing in any direction. There is now, however, evidence that the standardization rules recommended by the Fan Manufacturers' Section of the Associated Manufacturers of Electrical Supplies, are being followed out by fan manufacturers wherever possible. The standardization of nomenclature is particularly noticeable in the 1917 catalogs. The old term of "desk and bracket" has been replaced by the term "non-oscillating." Fans, therefore, are of two types, oscillating and non-oscillating.

In 1916 a number of manufacturers furnished cord and plugs with their fans and this year practically all the others have followed suit, so it is safe to say that less than 10 per cent of the 1917 output of fans will be furnished without cord and plugs. The fan manufacturers are now discussing standard length for the cord, but as yet no decision has been reached. Some are standing for one length and some another.

Considerable progress has been made in the standardization of ceiling fans. In this connection recommendations have been made regarding size, number of blades and number of speeds. Owing to the fact, however, that a number of ceiling fans which do not comply with this standard were left over from last year, it is doubtful if the recommended standard will become general practice before 1918.

In larger sized fans standardization is noticeable, but below the 12-in. sizes there is a greater variety of sizes among the different manufacturers.

UNCERTAINTY OF CONSUMER A FACTOR IN THE MARKET

Large Power Jobs Are Backward Because of Slow Deliveries and Because the Conditions of the Future Cannot Be Foreseen

Central station power salesmen, especially in the larger industrial centers, are finding that some of the big jobs they would like to close are assuming a difficult angle. It is impossible to get deliveries on the large special machines needed to make improvements in the customers' plants in less than six or eight months. The customer, however, freely admits that he cannot foresee the status of business conditions six or eight months in advance. He, therefore, hesitates to begin now improvements which will be completed at a time when he may have but little need for them. He hesitates to contract for service that, at the time it is to be delivered, he may not need. The fact that the general business situation and general market conditions are unsettled leads the ultimate consumer of electrical goods to proceed cautiously, and the fact that delivery dates are so far advanced as to eliminate the possibility of exercising this caution is delaying some large power and apparatus sales.

COPPER MARKET CONTINUES DULL

Absence of Buyers from Market and Little Disposition to Sell Promote Listlessness

No disposition is yet apparent on the part of holders of copper to sell, nor is there any indication of buying activities, either for immediate or future delivery. For these reasons the market continues to be dull, and prices remain nominal. Up to the early part of this week the rumors of war had apparently not affected the market.

Quotations on Tuesday were nominally as follows: February delivery, 33.75 cents; March delivery, 32 cents; second quarter, 31 cents; third quarter, 29.5 cents; and fourth quarter, 28.5 cents.

NEW YORK METAL MARKET PRICES

	Jan. 30 Selling Prices Bid	Jan. 30 Selling Prices Asked	Feb. 6 Selling Prices Bid	Feb. 6 Selling Prices Asked
Copper	£ s d		£ s d	
London standard spot	132 0 0		136 0 0	
Prime Lake	31.75	to 32.25†	32.00	to 33.00†
Electrolytic	32.50	to 33.50†	33.50	to 34.50†
Casting	29.25	to 29.75†	29.50	to 30.00†
Copper wire base	39.00†		39.75	to 40.75†
Lead	8.00		8.00	
Nickel	50.00		50.00	
Sheet zinc, f.o.b. smelter	21.00		21.00	
Spelter, spot	10.67½	to 10.92½†	10.17½	to 10.42½†
Tin, straits	45.75†		55.00†	
Aluminum, 98 to 99 per cent	52.00	to 54.00†	51.00	to 53.00†

OLD METALS

Heavy copper and wire	25.00	to 25.50†	25.50	to 26.00†
Brass, heavy	14.50	to 15.50†	15.00	to 15.50†
Brass, light	11.00	to 11.50†	11.50	to 12.00†
Lead, heavy	7.00	to 7.12†	7.25	to 7.37½†
Zinc, scrap	7.25	to 7.75†	7.50	to 7.75†

COPPER EXPORTS

Total tons to Feb. 6 1,110

†Nominal.

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Features of Four Makes of Fans

The descriptions of features of four makes of fans given here supplement an article that appeared in the Jan. 27 issue of the ELECTRICAL WORLD.

Sprague Electric Works of General Electric Company, New York City.—Sprague fans for 1917 will retain the features which have distinguished them in the past, chief among these being the single-field coil construction which is well known to the trade, having been used in the Sprague-Lundell fan since 1892. A new blade with a curved edge has been designed which is said to increase the efficiency of the fan. This blade also makes it possible to use an improved guard which is neat in appearance and rigid in construction. The complete fan, including motor body, base, blade and guard will be finished in black enamel. A 10-ft. cord and attachment plug will also be supplied with each 9, 12 and 16-in. fan. The fan as shipped from the manufacturer will therefore be ready to operate without additional labor or expense. Ceiling fans are of the four-blade type with a sweep of 56 in. and have three-speed switches. The Sprague "Midget" ceiling fan, which is furnished in either black or white enamel, and has a sweep of 32 in., is a very popular type, being used in large numbers in hotel sleeping rooms. All 12-in. and 16-in. non-oscillating fans may be readily converted to oscillating fans by the addition of an oscillating mechanism, which can be attached in a few minutes with the aid of a screwdriver.

Menominee Electric Manufacturing Company, Menominee, Mich.—A new low-priced 8-in. universal oscillator fan is being manufactured this year by the Menominee Company. It is built on

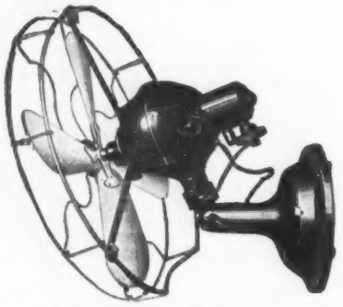


FIG. 1.—SPRAGUE CONVERTIBLE WALL AND DESK FAN

standard lines with a cast-iron body and base, and is provided with a standard oscillating mechanism and a universal motor. The blades and guard are of black japanned steel. This company will continue the manufacture of its 8-in. straight-type fan in which a few minor changes for improvement have been made. All fans this year, save for the exception of two types, will be equipped with black japanned guards, but the blades and guard holders will be made of brass, as formerly. The manufacture of special patented fans—the table fan and socket fan—will also be continued.

Lindstrom, Smith Company, Chicago, Ill.—The Breezer electric fan is especially adapted for use in small rooms, telephone booths, near the bedside, on the desk and in inclosed motor boats and automobiles. It is attractive in appearance, noiseless in operation, and is finished in nickel and black. Rubber feet are provided on the base so it will not mar the most highly polished surface. The regular 8-in. type fan is 11 in. high and 9 in. wide over all. When used as a wall fan it extends 9 in.

FIG. 2.—MENOMINEE 8-IN. UNIVERSAL OSCILLATOR

Units are designed for direct or alternating-current energy of any frequency and pressures from 8 to 120 volts.

Model 64, which is a regulation 8-in. fan, has a strong universal motor. The blades and guard are nickel-plated and highly polished, and the base and motor are finished in black. Rubber feet are attached so as not to mar furniture. The fans are furnished for any voltage from 12 up to 220 volts, direct or alternate current.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.—In addition to bringing out a new low-priced, 8-in. non-oscillating fan, the Westinghouse Electric & Manufacturing Company has incorporated a number of new features in its regular line. The complete line comprises oscillating and non-oscillating desk and bracket fans, gyrating ceiling, counter-column and floor-column fans, ceiling fans, and exhaust fans. The bodies of the fans are of drawn metal, or are die cast. The standard finish is dull black. The oscillating desk and bracket fans have three speeds and are made in 10, 12 and 16-in. sizes. The non-oscillating desk and bracket fans are made in 8, 10, 12 and 16-in. sizes, and with the exception of the new low-priced 8-in. fan, have three speeds. All 8 and 10-in. fans

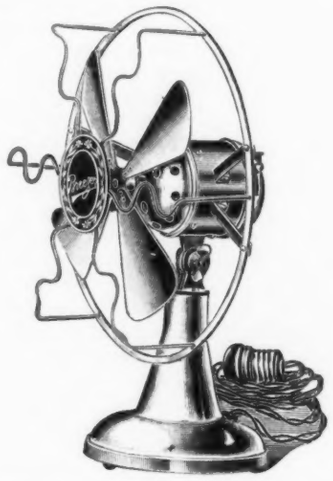


FIG. 3.—LINDSTROM-SMITH 8-IN. CONVERTIBLE FAN

have four blades and the 12 and 16-in. fans four or six blades. All desk and bracket fans are made for alternating and direct-current operation, and for frequencies from 25 to 60 cycles and pressures from 100 to 250 volts.

The blades used on the gyrator-type units have drawn-metal frames, and are known as the 12-in. "silent six" fans. One of the fan motors is geared to a mechanical drive operating on a stationary central pulley. The drive is

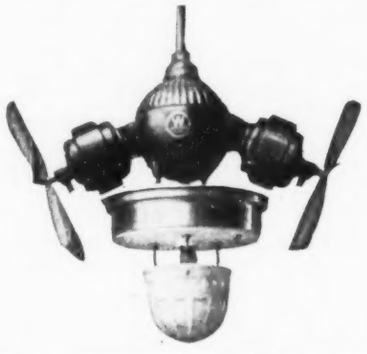


FIG. 4.—WESTINGHOUSE GYRATING CEILING FAN WITH BRASCOLITE UNIT

therefore positive and does not vary with the air reaction. The mechanism does not slow down and cannot revolve at excessive speed. Breeze at any angle desired, from horizontal to 35 deg. below horizontal, can be obtained by means of a positive wing-nut adjust-

ment at the side of the gyrating body. These fans operate at one speed, and current is controlled by a pull switch. While in the past these fans have been obtainable for use with ordinary electroliers, this year the ceiling gyrator

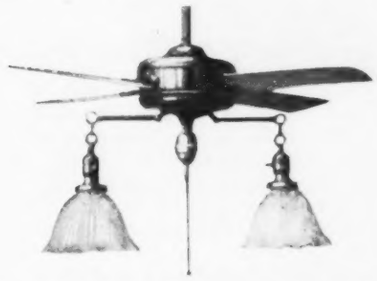


FIG. 5.—WESTINGHOUSE CEILING FAN WITH LOOP AND LINK UNITS

is provided with means for attaching Brascolites or Reflectolytes.

The ceiling fans have four blades. For alternating current with frequencies from 25 to 60 cycles and pressures from 100 to 115 volts, they are obtainable with blades having 32-in. or 56-in. sweep. The blades of the direct-current ceiling fans have a sweep of 32 in., 56 in. or 58 in. In the standard fans the air is thrown downward. On special order, however, the blades can be arranged to draw the air upward, a desirable arrangement in places where a downward breeze might disturb papers. Wooden blades with mahogany finish are used for the 58-in. and 56-in. fans. The blades for the 32-in. direct-current fan are also of wood, but have a natural finish. The blades for the 32-in. alternating-current fans are of aluminum, with frosted finish.

A 56-in. ceiling fan can be arranged for two-lamp or four-lamp electrolier attachments. The 32-in. fans can be arranged for single lamp or two-lamp electrolier attachment. A new loop and link attachment has been incorporated in the 32-in. and 56-in. alternating-current fans whereby two or four lamps respectively may be suspended by loops attached to two or four projecting arms. The lamps are mounted below the fan blades so that no shadows will be cast by the blades. Provisions have been made for equipping the 56-in. ceiling fans with Brascolites and Reflectolytes as well.

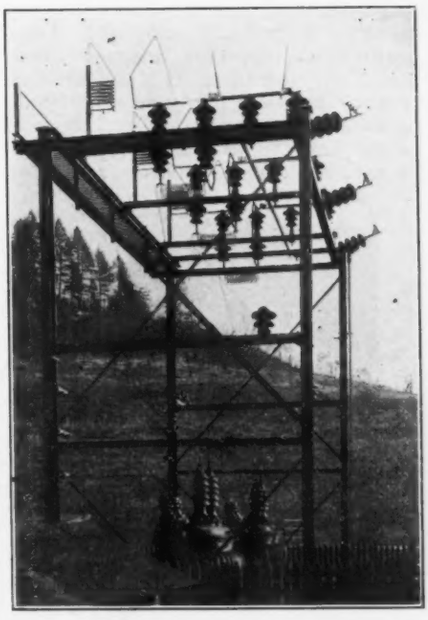
Features of Kokomo (Ind.) Oscillating Fan Company's line of fans for 1917 will be described in a later issue.

Closed Conduit Bushing

A closed pressed steel conduit bushing that has a protective top securely fastened into it is being offered to the trade by the Detroit Closed Bushing Company, Inc., 901 Kresge Bldg., Detroit, Mich. This top can be removed by the wireman with a screw driver or pliers. Attention is called to the fact that this protective feature leaves nothing to the memory of the workman. He must bush the conduit to complete the conduit installation, so that when the bushing is in place, the end of the conduit is also closed. The bushing is waterproof, thereby a protection against concrete and the entrance by foreign material.

44,000-Volt Outdoor Substation

A typical installation of the relatively inexpensive 44,000-volt type V B outdoor substations developed by the Delta Star Electric Company, of Chicago, Ill., is shown in the accompanying illustration. This steel tower substation is provided with four 35-ft. expanded-steel corner poles connected by cross members for carrying the high-tension control and protective units, transformer buses, etc. All parts are standardized, the steel being shipped "knocked down" and are easily assembled in the field. The three-pole switch is of the double-break per phase type with manually operated remote-control mechanism permitting



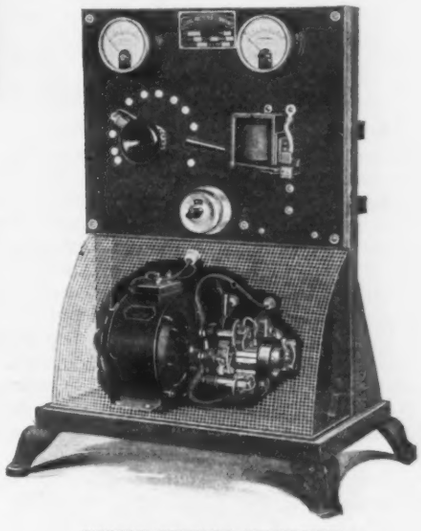
STEEL-TOWER SUBSTATION FOR 44,000-VOLT SERVICE

the switch handle to be locked near the ground level. The high-speed sphere-gap graded-resistance lightning arrester is so located that disturbances have a straight-line discharge path to earth, thus affording quick relief. Between this switch and the arrester is a right-angle fuse tap-off in conjunction with a long-turn cylindrical choke coil which presents a highly reactive path between the lightning disturbance and transformers.

Protection against short-circuits is secured by means of carbon-tetrachloride fuses in the tap-off circuit. Ordinary overloads are taken care of by the automatic oil breakers or fuses on the secondary side. By closely setting the secondary-breaker tripping mechanism and heavily over-fusing the primary side, fuse operation is confined to actual transformer or oil-switch failure, in which case the short-circuit is instantly cleared, thus preventing a local disturbance spreading to the main lines. With these stations the transformers are located at ground level and as the load requirements increase, the primary fuse and transformer ratings can be increased—no other change being necessary. These standard stations occupy 20 ft. by 10 ft. 7.5-in. ground area, thus permitting considerable increase in the transformer rating.

A Commutator Rectifier

The rectifier shown in the accompanying illustration is designed for the charging of small storage batteries, such as used with automobile ignition, lighting and starting sets. The single-circuit type is a self-contained charging plant that will charge from one to five batteries (or up to a total of 15 cells). By keeping the rectifier running twenty-four hours a day and taking out each battery as soon as fully charged, on an average, a total of thirteen 3-cell batteries, it is claimed, can be given a full charge in twenty-four hours, allowing for the average amount of residual charge. The rotating commutator principle is employed. Current from the alternating-current supply is brought to two terminals at the back of the switchboard. From these terminals the current passes through the line switch to a special induction-type motor. On the extended shaft of this motor are two collector rings and beyond them a commutator. The synchronous motor is of such design that no further attention need be given in starting than to simply close the line switch, at which time the motor will start readily and fall into synchronism, remaining so, it is said, even at a great reduction in voltage. The motor has no carbon brushes to keep in renewal. The only load on the motor



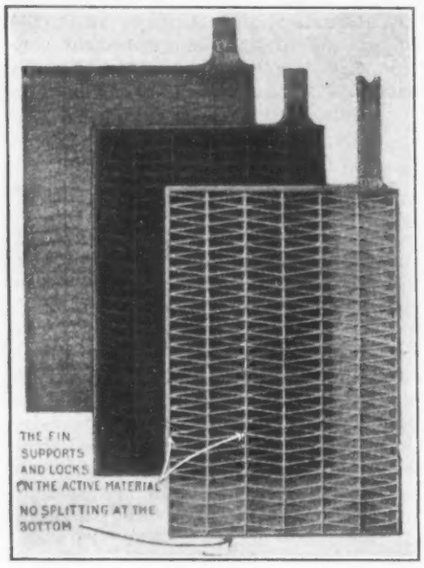
SINGLE-CIRCUIT RECTIFIER

is the friction of the brushes on the collector rings and the commutator.

Although the type shown here is of small capacity and low voltage to charge the class of batteries mentioned, larger sizes of the machines are made by the Stahl Rectifier Company, 538 South Clark Street, Chicago, Ill.

Grids for Storage Batteries

The General Lead Batteries Company of Newark, N. J., has developed the grid shown in the accompanying illustration which, it is claimed, will resist



GRIDS THAT HAVE OVERLOAD CAPACITY

sudden and unexpected strains or overloads. The diagonal ribs are intended to prevent bending at any point along the vertical bars and the fins along the vertical ribs must be broken before the plate can be bent. These fins, it is said, also decrease the length of the unsupported diagonal rib, permitting the lightening of the members without danger of their sagging during the pasting process. The fins afford projection around which the active material securely locks itself in which function they are assisted by the small shelves visible along the vertical bars.

Sewing-Machine Motor

A motor that can be readily attached to any make of stationary or drop-head sewing machine, new or old, with the exception of a few obsolete models, is made by the Westinghouse Electric & Manufacturing Company. When not in use, the motor, if mounted on a stationary-head machine, can be pushed back out of the way and the cover put on. If used on modern types of drop-head machines it can be dropped with the head. When desired, however, the motor can be removed readily by loosening one thumb screw, as it is light and portable. The complete outfit, which weighs only 7 lb., consists of a small motor which operates on either alternating or direct-current energy, a speed regulator with chain for connecting with treadle, 10 ft. of cord and plug and a round leather belt.

Being made of pressed steel, the regulator is light and substantial. There are two coils in series with the motor. When there is no pressure on the sewing machine treadle the circuit is open. With slight pressure on the treadle, a contact is made, both coils being in series, and as a greater pressure is applied the resistance is cut out in about 100 steps. Thus by varying the pressure, one stitch, or several hundred stitches a minute can be taken. When it is desired to wind the bobbin, the belt is slipped off the hand-wheel and on to the bobbin wheel. A helical spring tends to force the motor away from the head of the machine and thus always keeps the belt tightened. When folding up the machine it is only necessary to loosen the belt, disconnect the plug, and swing the motor around under the head. Two hooks are furnished for attaching the service conductors to the back of the machine. Felt pads underneath the base prevent the motor from scratching the machine.

Wireless Generator

A laboratory generator called the "Oscillion," for use wherever measurements and measuring instruments are employed, has been developed by the De Forest Radio Telephone & Telegraph Company, 1391 Sedgwick Avenue, New York City. It is a generator of pure sine wave high frequency oscillations, the frequency of which depends on the wave length employed, that may be used for transmission of radio tele-

GENERATOR OF PURE SINE WAVE HIGH FREQUENCY OSCILLATIONS

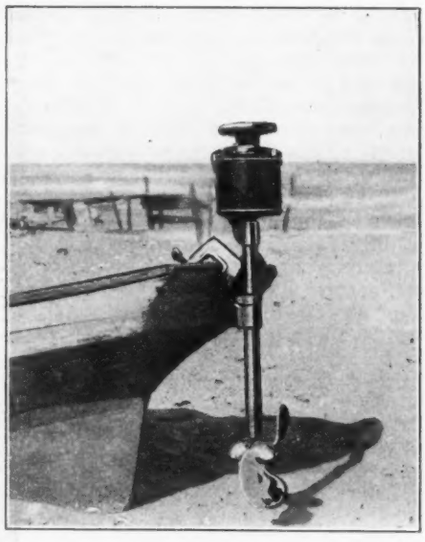
phone and telegraph signals over short ranges.

By using this instrument it is claimed one is enabled to do extensive research and calibrating work on all types of radio frequency circuits and instruments, for "heterodyne" work, beat and interference experiments. For example: A small difference of inductance or capacity can be quickly determined merely by associating one or two resonant circuits with the "oscillion" circuit, connecting a detector and telephone receivers to one of these circuits and tuning until a certain definite "beat note" is heard, say, one of 300 per second. Then vary the inductance, say, of two short parallel wires until wave frequency is altered by about twenty periods per second. (Determine these frequencies by comparison with a tuning fork note, etc.) After having determined the wave-length by means of a wave meter, the number of oscillations which caused change in frequency of "beat note" is known. Then if either capacity or inductance of full circuit is known, the minute change in capacity or inductance which caused the change in "beat note" can be determined.

An Electric Rowboat Motor

The electric motor for rowboats shown in the accompanying illustration is manufactured by the Jewel Electric Company, 112 North Fifth Avenue, Chicago, Ill. The motor is placed directly above the main driving shaft, which is contained in a telescopic tube, allowing the propeller to be adjusted to the correct distance beneath the surface of the water. The propeller is driven through a special type of propeller gearing which gives proper reduction between the motor and the propeller, this being necessary owing to the fact that the normal speed of the motor is about 3000 r.p.m. Above the motor is a small steering wheel, which enables the propeller to be turned to the right or left, or completely round if it is desired to reverse the direction of the boat. To this wheel may be fitted either a tiller or steering yoke, according to requirements. The outfit is made of aluminum and manganese alloy wherever possible, the purpose being to reduce the weight.

Attention is called to the fact that the motor complete, but without battery, weighs only 50 lb. The armature runs on ball bearings, and the commutator and brushes are of special design, suitable for low voltages, as the motor is used on from 6 to 12 volts. By means of a simple device the motor may be detached from the driving shaft and used for other purposes where power is required, and the current can be derived from the same batteries as used in the

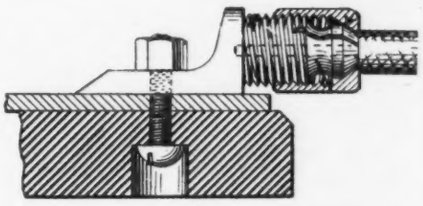


ELECTRIC MOTOR ADAPTED FOR USE ON ROWBOATS

boat. The storage batteries supplied with the regular equipment are two of 6-volt 120-amp.-hr. each. This company also supplies accumulators of 6 to 12 volts, having a rating of 60 to 120 amp.-hr.

Electrical Connector

An improved wire and terminal connector which it is claimed provides a simple, effective, strong and easily operated device is shown here as made



SIMPLE WIRE AND TERMINAL CONNECTOR

by the Frankel Connector Company of New York City. This connector is provided with a forked arm which may be secured to a binding post or screw bolt. The connector proper is provided with a longitudinal central bore. The free end is slotted longitudinally to form short gripping jaws. The wire is fastened to the connector by stripping a portion of the insulated covering and placing it into the longitudinal bore of the body. The sleeve screws up until the tapered part engages the tapered end of the connector body in such a way as to draw the two sides into contact with the wire.

Direct-Current Overload Relay

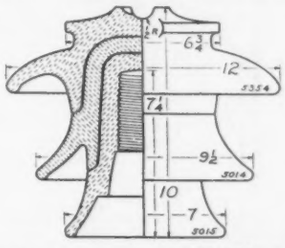
A relay has been developed by the Westinghouse Electric & Manufacturing Company, of East Pittsburgh, Pa., to give overload protection on direct-current circuits. It is particularly applicable for use in connection with three-wire generators having but four cables running to the switchboard, since by connecting the control coil of the relay to ammeter shunts, the circuit breakers can be mounted on the switchboard, yet controlled by the actual armature current as required by the Fire Underwriters. Without such connections the circuit breaker must be inserted in the circuit at the position of the ammeter shunt. This would require either the circuit breaker to be mounted at the generator, away from the switchboard, or an extra pair of leads to be run from the generator to the switchboard. This relay is known as the type TO. The operating part is a small two-pole electro-magnet with special winding. The magnet and an adjusting mechanism are inclosed in a dust-proof case of aluminum alloy.

The pull of the relay coils is opposed by a helical spring. When the pull exceeds the tension of the spring the contacts close. A calibrated adjustable arm is used to adjust the tension of the spring, in that way determining the voltage drop across the ammeter shunt at which the contacts will close. The relay contacts will close a circuit carrying 1 amp. When the circuit breaker trip coil requires more than this, an auxiliary relay switch should be used.

Type TO relays can be used with a standard 50-millivolt ammeter shunt (the same shunt that is used with the ammeter), without affecting the readings of the ammeter appreciably. By adjustment the contacts can be made to close at from 40 to 80 millivolts, corresponding to 80 to 160 per cent of full load, according to the setting made on a scale provided within the instrument allowing adjustments for all intermediate values. Where a relay is used, the circuit breaker should have auxiliary contacts to open the trip circuit when the breaker opens, thus relieving the relay contacts of this duty. Further, the type TO relay is instantaneous in operation. If a definite time element is desired a definite-time-limit relay should be used with it.

Pin Type Insulator

The Locke Insulator Manufacturing Company of Victor, N. Y., now manufactures ten designs of pin-type insulators for voltages ranging from 27,000 to 80,000. Several designs are offered



INSULATOR RATED AT 50,000 VOLTS

as new types for their rated voltages. In these units it is claimed that the electrical and mechanical characteristics provide an ample factor of safety for the most severe requirements. In the accompanying illustration is shown an insulator that has a line voltage rating of 50,000 volts. The dry arc over voltage is 175,000, the wet arc over voltage is 120,000 and the leakage distance is 23.5 in. The mechanical strength is 5000 lb.

Curb Station for Automobile Tire Inflation

An electric tire inflating outfit arranged for permanent mounting on sidewalks has been developed by the Black & Decker Manufacturing Company, 109 South Calvert Street, Baltimore, Md. This outfit is equipped with an electric tire inflating equipment such as described on page 100 of the Jan. 13 issue of the ELECTRICAL WORLD. There is a 4.5-in. 150-lb. pressure gage illuminated by a concealed lamp on this outfit. The upper compartment contains the inflating outfit and is normally kept locked so as to prevent anyone from tampering with it. The lower compartment contains a handy starting switch and a long hose. This curb station is fitted with an ornamental colum surmounted by a large opalescent globe having white lettering arranged in a green hexagon shaped field, the words "Free Air" being in large type and "Lectroflater Station" in small type.

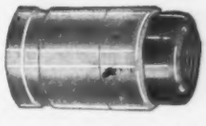
Starting and Lighting Equipment

The Westinghouse Electric & Manufacturing Company's automobile starting and lighting equipment for 1917 includes a complete line of starting motors and generators of the round frame type. The starting motors are built in a number of sizes and of such range as to be applicable to engines with a cylinder displacement up to 1000 cu. in. With the graduated range in which these motors are built it is possible to select a standard motor for any size engine which will exactly fulfil automobile requirements and still be the most economical application. The motors are all of the single-reduction type and equipped with the Bendix screw shift transmission for meshing with the flywheel gear. For the most economical performance, it is pointed out, the proper size battery, ranging from 80 amp.-hr. to 160 amp.-hr. capacity, must be used with a given size motor.

Corresponding sizes of generators are also being built for operation between engine and twice engine crankshaft speed. These machines are of the third-brush regulation type, a method which has proven very satisfactory where a large output is desired at low speed and where, at the same time, it must maintain the maximum output with reasonable relation to the ampere capacity of the battery. The approximate output of generators varies from 12 amp. maximum at 1500 r.p.m. for the smallest machine to 20 amp. maximum at 900 r.p.m. for the largest generators. Both generators and motors are designed primarily for bracket mounting, with the generator on the timing gear housing and the motor on the flywheel housing.

Medium-Base Reflector Socket

The reflector socket shown herewith has been brought out by the Arrow Electric Company, Hartford, Conn., and is built along the same lines as its regular mogul porcelain socket, except that it is designed for medium-base lamps. The socket is made of heavy porcelain and is constructed substantially throughout. The screw shells and binding posts are reinforced. An asbestos gasket is used between the inner and outer porcelain shells and a rubber gasket below the cap. All connections are made from the front of the socket. The socket is made with



SOCKET ADAPTED FOR USE WITH MEDIUM-BASE TYPE C LAMPS

⅜-in. and 0.5-in. metal caps, and ⅜-in. and 0.5-in. iron yokes. It is designed to take a standard shade-holder, and is particularly adapted for use with reflectors and fixtures employing medium-base Type C lamps.

Trade Notes

A. W. HARTIGAN of the New York sales department of the Western Electric Company has been appointed sales manager of The Electrical Alloy Company with headquarters at 41 Union Square, New York City.

THE WESTINGHOUSE LAMP COMPANY has officially announced the construction of a large new factory at Trenton, N. J., for the manufacture of incandescent lamps. This announcement closely follows that of the Westinghouse Electric & Manufacturing Company, which is to build a $7,000,000 plant at Essington, Pa.

The site for the lamp factory at Trenton covers about 5 acres, upon which will be built a plant of 200,000 sq. ft. of floor space. The cost of the buildings and equipment will be more than $1,000,000. When in full operation, the lamp factory will employ about 600 people, manufacturing approximately 1,500,000 lamps per month. The company at present has factories at Bloomfield, N. J., New York City and Milwaukee, Wis.

L. F. TANKARD has been promoted to manager of the New York office of the Diehl Manufacturing Company.

H. W. WATTS, who has been in the New York office of the Diehl Manufacturing Company for several years has been promoted to manager of the Boston office. Mr. Watts succeeds H. A. Howard, who has resigned to devote his entire time to the companies in which he is personally interested.

HOTPOINT ELECTRIC HEATING COMPANY has increased the list price on its tea kettles from $8 to $8.50, effective Feb. 1.

WESTERN ELECTRIC COMPANY has announced the terms for its 1917 appliance campaign. To encourage progressive fan merchandising the company offers cash prizes to the dealers that submit what is considered to be the best all around appliance fan sales campaign. The board of judges will be composed of representatives of ELECTRICAL WORLD, *Electrical Merchandising, Electrical Review, National Electrical Contractor, Electrical Record, Electrical Age* and the Society for Electrical Development. All data must be in the hands of the company by Oct. 1, 1917. Awards will be made as soon thereafter as practicable.

WALTER KIDDE, engineer-constructor, of 140 Cedar Street, New York City, has incorporated his organization under the title of Walter Kidde & Company, Inc. This business was established in 1900, and from the first the functions of the engineer and constructor were combined, as it was believed that in this way the common interests of the client and the constructor could be best served. Particular attention has always been given by Mr. Kidde's organization to the electrical equipment of plants, and they have kept in the vanguard of electrical progress. They have been strong advocates of electric drive from the very beginning, and they made some of the earliest installations of direct-driven machine tools. They were among the first to apply alternating current to factory operation; they were one of the early introducers of the 480-volt alternating-current system with induction motors, and did pioneer work in the installation of synchronous motors in isolated factory plants for the improvement of the power factor. The organization includes departments of construction, hydraulics, steam and mechanical engineering, electrical engineering and chemical engineering, which work in close co-operation, and which are usually associated on the same undertaking. Mr. Kidde's chief associates will now become directors and stockholders of the new corporation, the officers of which are: Walter Kidde, president; B. G. Worth, vice-president; I. R. Lewis, secretary and treasurer. These are all members of the board of directors, which also includes Henry Lang, who is vice-president of the Ingersoll-Rand Company, and E. S. Boyer, who is associated with the American Hard Rubber Company. Mr. Kidde's other principal associates, who comprise the "engineering board" of the corporation, are: A. B. Miller, Walter S. Wainright, M. I. Butterfield and E. Schwarz. The chief draftsman is Thorlief Fliflet.

CHICAGO MICA COMPANY has appointed W. B. Cosgrave 50 Church Street, New York City, as special representative covering the New York territory.

CROCKER-WHEELER SALES CONVENTION.—On February 8, 9 and 10 the Crocker-Wheeler Company, Ampere, N. J., held a sales department convention at the Robert Treat Hotel, Newark, N. J. A discussion of present and future conditions formed one of the features of this convention. On the evening of Feb. 9 a banquet was held. All of the officers and department heads of the company were present as well as all of the numerous district and branch managers of the company having charge of sales territories covering the entire country.

COMMERCIAL ELECTRIC SUPPLY COMPANY, 42 Congress Street, East, Detroit, Mich., has appointed Frederick Riebel, Jr., formerly district sales manager of the George Cutter Company, as general manager.

S. K. F. COMPANY, LTD., 47 King Street, West, Toronto, Ontario, Canada, has been recently organized to handle the S. K. F. products in Canada.

THE RICHARDSON-PHENIX COMPANY, Milwaukee, Wis., announces the opening of a sales office in Cleveland, located in the Builders' Exchange, in charge of W. J. Oettinger, in order to take care of the increased business in Ohio. Mr. Oettinger was formerly connected with the engineering department at the home office.

NEW WESTINGHOUSE PLANT—Announcement has just been made by the Westinghouse Electric & Manufacturing Company that the plot of ground recently purchased at Essington, near Philadelphia, will form a new industrial center for the Westinghouse Electric interests. The site embraces about 500 acres, with a frontage of approximately 1 mile on the Delaware River. Additional transportation facilities will be afforded by tracks from the Pennsylvania and Philadelphia & Reading Railroads. This new center will be devoted to the production of large apparatus, the first group of buildings being for power machinery, principally steam turbines, condensers, and reduction gears. The initial development will cost in the neighborhood of $5,000,000 or $6,000,000 occupying about one-fifth of the area of the entire plot. The group will consist of the following buildings: Two large machine shops, an erecting shop for heavy machinery, forge shop, pattern and pattern-storage shop, and power house. Work will begin on these as soon as satisfactory building contracts can be let. The number of employees to be engaged at the new plant has not as yet been definitely determined but will number several thousand people, and undoubtedly will in the future equal the number employed at East Pittsburgh, representing over 20,000 people.

New Incorporations

THE DIXIE ELECTRIC COMPANY of Sumter, S. C., has been incorporated with a capital stock of $3,000 by B. C. Wallace, Jr., and Young Shackelford.

THE ELECTRIC STEEL CASTING COMPANY of West Allis, Wis., has been incorporated with a capital stock of $300,000 by Leo G. Smith, Chauncey Yockey, F. G. Walter, C. F. Taylor and Clark Tennant. The initial units of the company plant will cost about $100,000.

THE DEPPE MOTORS CORPORATION of Wilmington, Del., has been chartered with a capital stock of $5,000,000 to manufacture and deal in motor cars, engines and generators of all kinds. The incorporators are: Herbert E. Latter, Norman P. Coffin and Clement M. Egner, all of Wilmington, Del.

THE CROWN ELECTRIC ILLUMINATING COMPANY of New York, N. Y., has been incorporated by W. Schlessinger, S. and D. Swartz, 78 East Houston Street, New York, N. Y. The company is capitalized at $5,000 and proposes to manufacture and deal in electric arc lamps, appliances, etc.

THE DUBILIER CONDENSER COMPANY of New York, N. Y., has been incorporated with a capital stock of $75,000 to manufacture and deal in machinery, apparatus, instruments and electrical machinery. The incorporators are: M. K. Morse, J. N. Essler and K. S. Neal, 111 Broadway, New York, N. Y.

THE MORROW INSULATING COMPANY of New York, N Y., has been chartered by H. M. Lewis, C. and J. J. Morrow, 674 Academy Street, New York, N. Y. The company is capitalized at $25,000 and proposes to do general contracting and electrical work.

THE INTERBOROUGH LIGHTING FIXTURE COMPANY of Brooklyn, N. Y., has been incorporated with a capital stock of $5,000 to manufacture and deal in gas, electric fixtures, metal goods, etc. The incorporators are: B. Markowitz, E. Fichandler and J. Ribak, 500 Thatchford Avenue, Brooklyn, N. Y.

THE WETZEL MECHANICAL STOKER COMPANY of Trenton, N. J., has been incorporated by James R. Barber, Miriam P. Swartz and E. Swartz of Trenton, N. J. The company is capitalized at $200,000 and proposes to manufacture and sell mechanical stokers, machinery and power-plant equipment.

THE INDESCO LIGHTING FIXTURES COMPANY of New York, N. Y., has been incorporated with a capital stock of $5,000 to manufacture and deal in electric and gas fixtures, motors, dynamos, and to do general electrical work. The incorporators are: H. E. Reid, A. and I. Frankenberg, 1200 Madison Avenue, New York, N. Y.

THE MOODY ENGINEERING COMPANY of New York, N. Y., has been incorporated by R. H. Jones, F. R. and R. D. Moody, 115 Broadway, New York, N. Y. The company is capitalized at $250,000 and proposes to do a general consulting, operating, electrical, mechanical and civil engineering business.

THE WHITE FLUID MOTOR COMPANY of Kansas City, Mo., has been incorporated by Thomas A. White, Z. D. Brown, I. J. Lane and I. A. Strauss. The company is capitalized at $50,000 and proposes to manufacture and deal in motor devices. The company is now being organized and will probably later arrange for the manufacture of the white fluid motor, the invention of T. A. White, which secures power from the wind for the generation of electricity.

THE QUASI-ARC WELDTRODE COMPANY of West Nyack, N. Y., has been incorporated by W. Moffatt, D. C. Alexander and F. W. Gordon, 61 Broadway, New York, N. Y. The company is capitalized at $150,000 and proposes to manufacture electrodes, weldtrodes, machinery, accessories, etc.

THE ELECTRO-DENTAL MANUFACTURING COMPANY of Philadelphia, Pa., has been chartered with a capital stock of $25,000 to manufacture electro-dental and surgical appliances, mechanical machines, etc. W. E. Hoagland, 47 West Thirty-fourth Street, New York, N. Y., is representative.

THE ADDISONE BOYCE CONDUIT COMPANY of New York, N. Y., has been chartered with a capital stock of $10,000 to manufacture and deal in electrical devices, appliances and to do a general contracting business. The incorporators are: T. M. Smith, E. G. Barton and A. S. Boyce, 16 West Thirty-third Street, New York, N. Y.

Trade Publications

RECTIFIERS.—The Stahl Rectifier Company, 536 South Clark Street, Chicago, Ill., has issued an illustrated leaflet descriptive of its commutator type of rectifier.

FANS.—The Robbins & Myers Company of Springfield, Ohio, is distributing an illustrated folder describing its 1917 line of fans.

FIXTURES.—A new fixture designed especially for nitrogen lamps is described in a leaflet issued by the Philadelphia Lighting Specialty Company, 1235 Filbert Street, Philadelphia, Pa.

POWER STATION.—The Almänna Svenska Elektriska A. B. has prepared an illustrated book descriptive of the Porjus Power Station and the electrification of the Riksgräns Railway. This company has compiled this brochure to commemorate this unique undertaking, in which it took part.

SALES SERVICE.—The February issue of Monthly Sales Service for use by members of the Society of Electrical Development, Inc., is now being distributed.

FANS.—The Western Electric Company is distributing an illustrated folder descriptive of its fans for 1917. The details for a merchandising contest are also given.

FANS.—The Robbins & Myers Company of Springfield, Ohio, is distributing two leaflets descriptive of its ceiling fans and its desk and oscillating fans.

SCREWS.—"How to Measure Screw Threads" is the title of Bulletin No. 1, recently published by the Greenfield Tap & Die Corporation of Greenfield, Mass.

ADDRESSING MACHINES.—The Elliott hand addressing machine is described in a leaflet issued by the Elliott Addressing Machine Company of Cambridge, Mass.

New England

BOSTON, MASS.—Plans have been prepared by the Edison Electric Illuminating Company for the erection of a substation. Bigelow & Wadsworth, 120 Tremont Street, are architects.

BOSTON, MASS.—The Commissioner of Public Works has recommended to the City Council an appropriation of $5,000 for the installation of an ornamental lighting system on Meridian Street from Summer Street to the Meridian Street Bridge, in East Boston.

BOSTON, MASS.—Bids will be received until Feb. 21 for the sale of nine 3-wire feeder panels, two 3-wire generator panels, two 225-hp. vertical cross compound Buckeye engines and miscellaneous piping, at the Boston, Mass., navy yard, etc. For details see proposal columns.

FRANKLIN, MASS.—The Union Light & Power Company of Franklin will soon begin work on the erection of a new transmission line from North Attleboro to Mansfield, giving the company a ring transmission through the towns of Franklin, Wrentham, Mansfield, North Attleboro. The company is also erecting extension to its high tension lines to take on the Chocolate Refiners Company and the New England Steel Company of Mansfield. A new transmission line from Woonsocket to North Attleboro has recently been completed by the company.

MANSFIELD, MASS.—Three 100-kw. and three 125-kw. 13,000-volt transformers are being installed in the municipal electric-light plant; about 1 mile of 13,000-volt transmission line will be erected in Mansfield and two 200-kw. 13,000-volt transformers will be installed. George W. Wood is manager.

NEW BEDFORD, MASS.—Bids will be received by the Board of Mayor and Aldermen, Room 309, Municipal Building, New Bedford, Mass., until Feb. 21, for centrifugal pump and electric motor for the intercepting sewer system. Form of proposal and further information may be obtained at the office of William F. Williams, consulting engineer.

PEABODY, MASS.—A 1500-kw. General Electric turbine, with Wheeler condenser and Dean jet condensers for reciprocating engines and spray pond are being installed in the municipal electric-light plant. A 125-kw. General Electric generator is being removed. W. D. King is manager.

Middle Atlantic

ALBION, N. Y.—Bids will be received by William B. Dye president of board of managers, Western House of Refuge, Albion, until Feb. 13, for construction of new cottage, including electric work, heating and plumbing at the Western House of Refuge. Plans and specifications may be consulted at the Western House of Refuge, Albion, at the New York office of the Department of Architecture, Room 1224, Woolworth Building, New York City. Drawings, specifications, etc., may be obtained at the Department of Architecture, Albany, N. Y. Lewis F. Pilcher is state architect.

BAINBRIDGE, N. Y.—The Standard Light, Heat & Power Company of Unadilla has applied to the Public Service Commission for permission to construct an electric plant in Bainbridge.

BEDFORD HILLS, N. Y.—Bids will be received by James Wood, president board of managers of New York State Reformatory for Women, Bedford Hills, N. Y., until Feb. 16 for electric work and rewiring building at the New York State Reformatory for Women. Drawings and specifications may be consulted at the State Reformatory for Women, Bedford Hills, at the New York office of the Department of Architecture, Room 1224, Woolworth Building, and at the Department of Architecture, Capitol, Albany. Lewis F. Pilcher is State architect.

BRONXVILLE, N. Y.—The Village Planning Commission has passed a resolution suggesting to the Board of Trustees that some arrangement be made with the Westchester Lighting Company for extending the underground electric conduit system from the center of the village, in connection with the next street-lighting contract with the company.

GENEVA, N. Y.—Bids will be received by Dr. W. H. Jordan, director State Agricultural Experiment Station, Geneva, until Feb. 23, for construction, heating, plumbing, drainage and electric work for administration library and demonstration building at the State Agricultural Experiment Station, Geneva. For details see proposal columns.

JAMESTOWN, N. Y.—The contract for installing new signal system and speed control appliances on the lines of the Chautauqua Traction Company and the Jamestown, Westfield & Northwestern Railway Company has been awarded to the Julian Beggs Signal Company of Terre Haute, Ind. The cost of the work is estimated at $250,000.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

NEW YORK, N. Y.—The New York, Westchester & Boston Railway Company, it is reported, will build an extension of its railway from White Plains to Danbury.

NEW YORK, N. Y.—The Interborough Rapid Transit Company has acquired a site on East Fifty-seventh Street, between Third and Lexington Avenues, on which it proposes to erect a transformer station to distribute electricity to operate the trains in the new Lexington Avenue subway and other lines the company operates.

ROCHESTER, N. Y.—Plans are being prepared by the Vacuum Oil Company of Rochester for the erection of a new can factory and a new box factory; also for the reconstruction of its boiler house, which will include the installation of coal-handling equipment. The cost of the new equipment is estimated at $100,000 and the buildings at $135,000.

HAMBURG, PA.—Arrangements have been made by the Metropolitan Electric Company of Reading to supply energy to the Hamburg Gas & Electric Company from its Reading plant for local distribution. The plant of the Hamburg company will be closed down and held for emergency service.

JOHNSONBURG, PA.—Preparations are being made by the Johnsonburg Light & Power Company for the installation of a new street-lighting system in this borough.

MAHANOY CITY, PA.—The Reading Coal & Iron Company is planning to install an electric power plant in connection with other improvements at its Knickerbocker mine. The plant will supply electricity for both lamps and motors.

NORRISTOWN, PA.—The Board of Supervisors of West Norristown has awarded the Counties Gas & Electric Company of Norristown a contract for the installation and operation of a street-lighting system.

PHILADELPHIA, PA.—Plans have been filed by the Quaker City Iron Works for the erection of a new boiler house and engine plant at Salmon and Tioga Streets.

PHILADELPHIA, PA.—The Philadelphia & Reading Railroad Company is contemplating the construction of a new power house at its yards at Erie Avenue and American Street.

PHILADELPHIA, PA.—The installation of a trackless trolley to serve the Byberry section has been recommended by M. J. Ryan, Public Service Commissioner, in connection with plans for the extension of the Frankford elevated line to this point.

PITTSTON, PA.—Tentative plans, it is reported, have been prepared by the Scranton Electric Company for the installation of a large plant in Pittston. Duncan T. Campbell of Scranton is manager.

SWEDELAND, PA.—Extensive improvements are contemplated to the local plant of the Alan Wood Iron & Steel Company of Philadelphia, including the installation of an electric traveling crane with sufficient capacity to lift loaded freight cars. The cost of the improvements is estimated at $1,000,000.

WAVERLY, PA.—The Village Council has awarded the Sayre (Pa.) Electric Company a new contract for lighting the streets of the village for a period of five years, which provides for the installation of 150 lamps of 100 cp., 30 of 150 cp. and two of 250 cp. Nitrogen-filled lamps will be used.

BAYONNE, N. J.—The Lower Broadway Business Men's Association is negotiating with the City Commissioners for the installation of a new street-lighting system along that thoroughfare.

CLAYTON, N. J.—The local electric-light plant, owned by the former Moore Glass Company, has been acquired by the South Jersey Gas Company, which has been granted a franchise to supply electricity for lamps and motors in this borough and vicinity.

EAST ORANGE, N. J.—Bids will be received by the Board of Education, East Orange, until Feb. 13 for electric and gas lighting fixtures in the new extension to the Elmwood School, Burnett Street. Specifications are on file at the office of the Board of Education, High School Building, and at the office of Guilbert & Betelle, 665 Broad Street, Newark, N. J.

KEARNY, N. J.—The Egyptian Lacquer Company contemplates the construction of a new boiler plant in conection with other buildings at its works on Passaic Avenue. The cost of the buildings is estimated at $50,000.

NEWARK, N. J.—The Board of Freeholders has adopted resolutions providing for the installation of new boilers at Overbrook Hospital.

NEWARK, N. J.—The Robison-Roders Company is erecting a new power plant at its feather goods factory, 27 New Jersey Railroad Avenue, for auxiliary service. The cost is estimated at $25,000.

NEWTON, N. J.—The town committee is considering a proposal submitted by the Newton Electric & Gas Company for the installation of an electric street-lighting system to replace the gas lamps now in use. William McClintock is local manager.

BALTIMORE, MD.—The Pennsylvania Railroad Company is contemplating enlarging its Calvert Street terminals and other local improvements, involving an expenditure of $10,000,000. The motive power for hauling the trains through the tunnel and elsewhere in the city will be changed from steam to electricity.

OCEAN CITY, MD.—Plans are being prepared for the construction of an electric railway along the beach on Fenwick Island, 8 miles long. Thomas E. O'Connell, of Phoenixville, Pa., is reported interested.

HARTLAND, W. VA.—Final plans have been prepared for the erection of an electric generating station for the Hartland Power Company, in Hartland. The initial installation provides for a 1000-kw. condensing steam turbine; five miles of 13,200-volt transmission line will be erected to distribute electricity for coal mines. W. S. Barstow & Company, 50 Pine Street, New York, N. Y., are engineers.

RALEIGH, W. VA.—A tract of several thousand acres of land in Raleigh County along the New River has recently been purchased by A. D. Preston of Beckley and C. L. Miller of Hinton. The new owners, it is understood, propose to build a large hydroelectric plant and supply electricity to the coal field communities in this county.

NORFOLK, VA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 19, for furnishing and installing one 40-ton and four 10-ton bridge cranes (electrically operated) at each of the navy yards Norfolk, Va.; Philadelphia, Pa., and Puget Sound, Wash. Plans and specifications can be obtained on application to the above bureau or to the commandants of the navy yards named.

WASHINGTON, D. C.—Bids will be received by the general supply committee, Treasury Department, Washington, D. C., until March 7, for furnishing as may be ordered during the fiscal year ending June 30 1918, supplies as follows: Class (6)—Electrical engineering and plumbing supplies; (17) motor trucks, etc. Proposal blanks and further information may be obtained upon application to the general supply committee, Auditors' Building, Washington, D. C.

WASHINGTON, D. C.—Bids will be received at the office of the secretary of board of commissioners, Room 509, District Building, Washington, D. C., until Feb. 20, for construction of a central garage on D Street, between Thirteenth and Thirteen and One-half streets, Northeast, Washington. Blank forms of proposal, specifications, etc., may be obtained from the chief clerk, Engineer Department, Room 427, District Building, upon deposit of $5.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Boston, Mass., Schedule 677—144 (boiler) tube brushes. Philadelphia, Pa., Schedule 687—one electric capstan, five electric winches; Schedule 678—miscellaneous annealed brass wire. Newport, R. I., Schedule 667—2000 copper gaskets; Schedule 686—200 turbine wheels. Mare Island, Cal., Schedule 683—two air compressor plants. Norfolk, Va., Schedule 678—miscellaneous spring hard brass wire, miscellaneous iron or steel wire, miscellaneous bronze phosphor wire, miscellaneous crucible steel wire. Philadelphia, Pa., and Norfolk, Va., Schedule 678—miscellaneous soft copper wire. Washington, D. C., Schedule 677—44,000 ft. steel conduit. Charleston, S. C., Schedule 696—13 contact maker's gongs, two electric heaters, two contact bells makers, etc., two gong pulls four portable ventilating sets, one each fire-room telegraph transmitter and indicator, two mechanical engine telegraph transmitters, one indicator, five angle rudder transmitters, one shaft revolution transmitter, one electric whistle outfit. Brooklyn, N. Y., Schedule 688—ten motor-driven sewing machines. Applications for proposal blanks should designate the schedule desired by number.

North Central

FLINT, MICH.—The Michigan United Railways Company of Jackson is planning to build an electric railway between Owosso and Flint this year. The third-rail system will be used.

JACKSON, MICH.—The Commonwealth Power, Railway & Light Company, through its subsidiary, the Consumers' Power Company of Maine, is building on the Manistee and Ausable Rivers two new additions to its power system in Michigan. At the Manistee Junction dam 23,000 hp. will be in operation by next December, and two plants of 12,000 hp. each on the Ausable River will be ready by June, 1918. The company already has four plants on the river with a combined capacity of 60,000 hp.

AKRON, OHIO.—The Northern Ohio Traction & Light Company has installed a 7500-kw. generating unit in its substation in Akron, to be used until two new 20,000-kw. units have been installed. The first of these units will be in use in April, and it is expected to have the second unit in operation in June. The latter part of the year the boiler capacity of the plant will be increased by 4000 hp. Considerable extensions will be made to the transmission and distribution lines in the Canton-Akron district this year.

CLEVELAND, OHIO.—Application has been filed by the Cleveland Electric Illuminating Company with the Public Utilities Commission for permission to issue $2,000,000 in bonds for improvements and extensions to its property.

CLEVELAND, OHIO.—The City Council has engaged J. H. Tufel, engineer, 1526 East Eighty-fifth Street, Cleveland, to prepare plans for extensions to the municipal electric lighting plant, to cost about $500,000. The work will include an addition to power house and installation of new equipment, etc. W. E. Davis is commissioner of lighting.

DELPHOS, OHIO.—Improvements involving an expenditure of about $100,000 are contemplated to the electric plant of the Northwestern Ohio Light Company, a subsidiary of the Federal Power & Light Company of Boston, Mass. The plans provide for rebuilding the transmission line between Delphos and Van Wert, changing the voltage from 13,000 to 30,000, which will require about 35 miles of wire. A concrete substation will be erected near the present plant to house the high-tension transformers, switches, lightning arresters and other equipment. A coal-conveying system will also be installed. R. A. Langworthy of Boston, Mass., is chief engineer; W. P. Hurd of Van Wert is district manager.

CLAY, KY.—Mitchell & Dunnigan, owners of the local electric-light plant, are contemplating the erection of an electric transmission from Clay to Dixon to supply electrical service there.

ELKHORN CITY (P. O. PRAISE), KY.—The City Council is considering the installation of a municipal electric-light plant, besides furnishing a water power upon a municipal basis. Estimates would glady be received.

GLASGOW, KY.—The Kentucky Utilities Company of Louisville, which recently took over the property of the Glasgow Electric Light & Ice Company, will erect an electric transmission line to Cave City and Horse Cave early in the spring. Albert Boyd is local superintendent.

GREENSBURG, KY.—The electric plant, franchises and holding of the Moss Milling Company of Greensburg, it is reported, will be sold at auction on Feb. 12.

HAZARD, KY.—The Kentucky River Power Company, it is reported, has plans for enlarging its central power station now under construction and will install three 2000-hp. turbines. Larger buildings will be constructed to provide space for additional equipment. One turbine will be placed in operation very soon. The company now supplies electricity for 16 mines in Perry County and has 50 miles of transmission lines. R. L. Cornell is general manager.

LA CENTER, KY.—The La Center Light & Power Company, recently organized, it is reported, will enlarge the local plant. S. T. Payne is president.

LOUISVILLE, KY.—Plans have been prepared for the construction of a terminal warehouse in Louisville for the Warehouse Architectural & Engineers' Company, to cost about $2,500,000. It is to be equipped with electric elevators and electric trucks, and will provide accommodations for manufacturing plants. A cold-storage unit will probably be added later. C. H. Moores, of Chicago, Ill., is president.

PIKEVILLE, KY.—Plans are being considered for extensions and improvements to the electric-light plant and water-works system. Estimates will be received for a 90-hp. engine and a 50-kw. generator.

DECATUR, IND.—The city of Decatur has awarded contract for a 500-kw. steam turbo-generator and condenser, to be installed in the municipal electric plant this year. M. J. Mylott is manager.

HOBART, IND.—The town of Hobart has awarded contract to the General Electric Company for a 300-kw. condensing steam turbine, to cost $9,100, a Schutte Koerting multi-jet condenser, at $1,650, for delivery Oct. 1, for the municipal electric-light plant. Work will begin about March 15 on the erection of 1 mile of rural transmission line, single phase, 60 cycles, 2250 volts. M. H. Owen is superintendent.

NASHVILLE, IND.—The Town Council has voted to install 21 additional street lamps in the town.

PERU, IND.—The City Council has authorized A. C. Herren, manager of the municipal electric-light plant, to ask for bids on two new generating units, one 500 kw. and the other 750 kw., and for a new boiler of about 300 hp. capacity for the municipal electric-light plant.

TERRE HAUTE, IND.—The Board of Park Commissioners is asking for bids for the installation of an ornamental lighting system in Voorhees Park and Memorial Park. J. D. Fitzpatrick is superintendent of board.

CHICAGO, ILL.—Plans are being prepared for the construction of a power house for the James S. Kirk Company, 209 South La Salle Street, to cost about $200,000. E. C. and R. M. Shankland are mechanical engineers; R. E. Pingrey is architect, all of 209 South La Salle Street.

COLUMBIA, ILL.—Extensive improvements are contemplated to the municipal electric-light plant, including the installation of two new engines, a generator and one boiler. When improvements are completed a 24-hour service will be established. E. L. Rauch is general superintendent.

DECATUR, ILL.—The Department of Public Property is contemplating the erection of 300 new ornamental lamp standards, the installation of one 12-kw. constant-current regulator and about 60 lamps of 250 cp. in Fairview Park. The municipal plant furnishes electricity for lighting the streets and public buildings. Commercial service is supplied by the Decatur Railway & Light Company. W. Logan Rice is general superintendent.

MERRIMACK, WIS.—Plans are being considered by the towns of Merrimack, Sumpter and Prairie du Sac to erect local distribution systems and transmission lines to connect with the hydroelectric plant here.

MILWAUKEE, WIS.—Commissioner Simmons has been authorized to make investigations as to the feasibility of erecting a new power house for the city hall power plant, or whether to purchase energy from the Milwaukee Light, Heat & Traction Company.

PRAIRIE DU SAC, WIS.—The Town Council, it is reported, is contemplating the erection of an electric transmission line to connect with the hydroelectric plant at Merrimack to secure electricity to operate the local system.

ROTHSCHILD, WIS.—The Marathon Paper Mills Company has engaged Vaughan & Meyer, electrical engineers, Majestic Building, Milwaukee, to prepare plans for a new power plant. The equipment will include two 400-hp. boilers, automatic stokers, feed pump, heater and auxiliary equipment.

SUMPTER, WIS.—The town of Sumpter is reported to be considering the installation of an electric distribution system and the erection of transmission lines to connect with the hydroelectric plant in Merrimack.

DULUTH, MINN.—The installation of a number of additional units to the street-lighting system has been authorized by the City Commissioners.

ST. PAUL, MINN.—Plans for the installation of an ornamental street-lighting system in Robert Street, from Eighth to Central Avenues, have been approved by the City Council. Plans are also being considered for the installation of ornamental lamps in Rice Street.

AMES, IOWA.—Orders have been placed by the Electric Light Department for a 600-kw. Curtis turbine and a Westinghouse Le Blanc jet condenser, for the municipal electric-light plant. Charles E. Warsaw is manager.

ANTHON, IOWA—Bids will be received by L. L. Lucas, town clerk, until Feb. 15 for construction and furnishing equipment for an electric-light, power and heating plant.

CEDAR RAPIDS, IOWA.—The Board of State Railroad Commissioners has granted the Iowa Railway & Light Company of Cedar Rapids a franchise to erect and operate electric transmission lines to supply electricity for lamps, heaters and motors in Linn and Benton Counties.

EARLING, IOWA.—The Stinn Improvement Company contemplates extensions and improvements to its plant in the near future, including the installation of a 35-hp. oil engine and a 3-wire generator, 110 and 220 volts. It is also considering changing the system from direct to alternating current. E. L. Stinn is engineer.

GRINNELL, IOWA.—The Iowa Light, Heat & Power Company has been granted permission by the Board of State Railroad Commissioners to erect and maintain electric transmission lines to supply electricity for lamps, heaters and motors in Carroll County.

MARENGO, IOWA.—The Board of Railroad Commissioners has granted the Iowa Electric Company of Marengo a franchise to erect and operate an electric transmission line in Washington, Johnson and Muscatine Counties to supply electricity for lamps, heaters and motors.

PERRY, IOWA.—The Iowa Railway & Light Company is erecting a new power plant in Perry, the buildings being practically completed. The company is extending its service in this vicinity, which will be supplied from the new plant.

SERGEANT BLUFF, IOWA—Bids will be received by the board of education, consolidated school district, Sergeant Bluff, until March 8 for construction of school building. Separate bids to be submitted for electric wiring, heating and plumbing. William L. Steele, United Bank Building, Sioux City, is architect.

NEW CAMBRIA, MO.—Preliminary estimates have been completed for the installation of an electric-lighting system in New Cambria. The plans provide for new transmission lines and distribution system. E. B. Murray, 920 Walnut Street, Kansas City, Mo., is engineer.

RIVER MINES, MO.—The Doe Run Lead Company is contemplating the installation of two 3000-kw. steam turbines, seven 500-hp. boilers and other equipment at its mines. Viele, Blackwell & Buck, 49 Wall Street, New York, N. Y., are consulting engineers.

ST. LOUIS, MO.—Bids will be received by E. R. Kinsey, president of board of public service, St. Louis, until Feb. 16, for furnishing and installing a 1000-gal. steam-driven centrifugal pump at the low-service pumping station at Chain of Rocks.

ST. LOUIS, MO.—The Granite City Steel Works, Second and Destrehan Streets, St. Louis, is remodeling its plant, including the installation of electrical power, at a cost of about $100,000. The company is a subsidiary of the National Enameling & Stamping Company of Granite City, Ill.

WEBB CITY, MO.—The installation of a municipal electric-light plant and ice factory in Webb City is under consideration.

MINOT, N. D.—The contract for the installation of an onamental lighting system in Minot has been awarded to the Kopald Electric Company of Minot. This is the second contract awarded to the Kopald company for the installation of ornamental lamps in Minot.

DAYKIN, NEB.—All bids submitted Jan. 24 for construction of a municipal electric-light plant have been rejected. J. O. Greenawalt is clerk.

FREMONT, NEB.—The contract for electric wiring for the court house at Fremont has been awarded to the Wright Electric Construction Company of Fremont, at $4,300.

HASTINGS, NEB.—Bids will be received by the city of Hastings at once, it is reported, for a 300-hp. boiler. The cost is estimated at $10,000.

LINCOLN, NEB.—The Lincoln Traction Company has leased its power plant to the Commonwealth Power Company of Lincoln, and has entered into a contract with the power company to purchase energy to operate its system for a period of 49 years. The Commonwealth Company contemplates building dams and power stations on the Blue River to furnish power for the local traction system and the interurban railway to Omaha.

SUTHERLAND, NEB.—All bids submitted for the construction of an electric-light plant for the village have been rejected by the Village Board. The engineer's estimate of the cost is placed at $7,500.

BELOIT, KAN.—The City Council has engaged Black & Veatch, Interstate Building, Kansas City, Mo., consulting engineers, to prepare plans for an addition to the municipal electric plant and a water filtration and softening plant for the water-works system. Improvements to the electric plant will include a 150-hp. boiler, steel stack and additional electric equip-

ment. The cost of the work is estimated at $35,000. F. A. Darst is superintendent.

CALDWELL, KAN.—At an election held recently the proposal to issue $80,000 in bonds for improvements to the electric-light plant and water-works was carried. Burns & McDonnell, Interstate Building, Kansas City, Mo., are engineers.

FORT SCOTT, KAN.—At an election held recently the proposal to issue $168,000 in bonds for the installation of a municipal electric-light and power plant was carried.

HIGHLAND, KAN.—The Hiawatha Light, Power & Ice Company is contemplating the erection of an electric transmission line between Robinson and Highland to supply electricity to the local plant, owned by M. V. Warner.

LONG ISLAND, KAN.—The installation of a municipal electric-light plant in Long Island is under consideration.

MANHATTAN, KAN.—Bonds to the amount of $200,000 have been authorized by the stockholders of the Manhattan City & Interurban Railway Company, the proceeds to be used to pay outstanding indebtedness and for extensive improvements. W. R. West is president.

MORAN, KAN.—The contract for construction of the proposed municipal electric plant and water-works system has been awarded to the Connor Construction Company, 4008 Montgall, Kansas City, Mo. All material and equipment, it is understood, has been purchased by the city. The cost of the work is estimated at $40,000.

MULLINVILLE, KAN.—Preparations are being made for the installation of a municipal electric-light system in Mullinville. Energy to operate the system will be secured from the Midland Water, Light & Ice Company of Dodge City. An electric transmission line will be erected to Bucklin City connecting with the lines of the Midland company there. The cost of the system is estimated at $10,000. W. B. Rollins & Company, Railway Exchange Building, Kansas City, Mo., are engineers.

SEDAN, KAN.—Bids will be received by the Board of County Commissioners of Chautauqua County, Sedan, until Feb. 20 for construction of a fireproof court house, separate bids to be submitted as follows: General contract; heating and plumbing; electric wiring and lighting fixtures; wood furniture. George P. Washburn & Son, Ottawa, Kan., are architects.

SYRACUSE, KAN.—New machinery, it is expected, will be installed this season at the municipal electric-light plant. The cost is estimated at $15,000. J. C. Riley is manager.

Southern States

LUMBERTON, N. C.—Bids will be received by the town of Lumberton until Feb. 21 for the purchase of $51,000 of 20-year serial bonds issued by the town of Lumberton. The proceeds will be used for improvements to water and light plants. Ira B. Townsend is clerk and treasurer.

MORTIMER, N. C.—C. M. McCorkle of Newton, N. C., has purchased a waterpower site on Wilson's Creek and contemplates the construction of a hydroelectric plant to develop about 2000 hp.

SPRING HOPE, N. C.—The City Council is considering improvements to the municipal electric-light plant and waterworks system.

STATESBORO, GA.—An election will soon be held to submit to the voters the proposal to issue $30,000 in bonds for improvements to the electric plant. Daniel L. Gould is superintendent.

ZEPHYRHILLS, FLA.—The Zephyrhills Electric Company now has 4500 ft. of transmission line under construction. The installation of refrigerating apparatus this summer is under consideration by the company. L. N. Gilbert is owner and manager.

YAZOO CITY, MISS.—The Public Service Commission has been authorized to purchase a new generator and other necessary equipment for the municipal electric-light plant, involving an expenditure of between $20,000 and $25,000.

EARLE, ARK.—Plans are being prepared by the Earle Light, Water & Ice Company for the installation of a new electric plant to replace the one recently destroyed by fire.

EL DORADO, ARK.—The Citizens' Light & Power Company, recently organized, has applied for a franchise to supply light and power in El Dorado.

NEW ORLEANS, LA.—The Roberts-Wiegand Pickle Company of New Orleans, recently incorporated, is planning to install one 100-hp. boiler, engine, electric motors, sanitary pumps, vinegar pumps and other mechanical apparatus. P. H. Roberts, Metropolitan Bank Building, New Orleans, is interested in the project.

AMORITA, OKLA.—Preparations are being made by C. H. Peebles for the installation of an electric light plant in Amorita. An engine, it is understood, has been purchased.

LAWTON, OKLA.—The power plant and pumping station of the Night & Day Oil Company at Lawton was recently destroyed by fire, causing a loss of about $12,500.

DENTON, TEX.—The Acme Pressed Brick Company is planning to rebuild its power plant, recently destroyed by fire, causing a loss of about $12,000. W. R. Bennett is president.

JACKSBORO, TEX.—The Mill & Elevator Company, which recently purchased the local electric-light plant of the Jacksboro Ice & Light Company, is planning to install new machinery and make other improvements to the system.

KOSSE, TEX.—The Kosse Light & Power Company is planning to install an electric-light and power plant, to cost about $12,000. L. T. Gibbs, W. D. Allen and W. E. Allen all of Kosse are interested in the company.

PANHANDLE, TEX.—The Council is considering calling an election to submit to the voters the proposal to issue bonds for the installation of a municipal electric-light plant.

SAN ANTONIO, TEX.—The City Council has rejected all bids submitted for the installation of a police signal alarm system.

Pacific States

EVERETT, WASH.—Notice of appropriation of water rights (10,000 cu. ft. per second) on the Sauko River have been filed with the county auditor by T. Ross Carson of San Diego, Cal., and Walter von Prussentin of Ferndale, Wash. It is proposed to develop the water power to generate electricity for distribution in Skagit, Snohomish and King Counties.

OROVILLE, WASH.—The City Council has approved the ordinance granting the West Okanogan Valley Irrigation District a franchise to construct and operate electric transmission lines in Oroville.

WHITE SALMON, WASH. — Extensive improvements involving an expenditure of about $355,000, are contemplated by the Pacific Power & Light Company of Portland, Ore., in this district. Rights of way for the erection of new lines to connect the systems of White Salmon and vicinity with those of Hood River and The Dalles are now being secured.

SPRINGBROOK, ORE.—The Yamhill Electric Company of Newberg is planning to extend its transmission line to Springbrook to supply electricity in this town and adjacent territory.

BURBANK, CAL.—The city of Burbank (Electric Light Department) has recently awarded the California-Arizona Construction Company of Los Angeles a contract for the installation of 88 ornamental single-lamp standards (concrete posts), equipped with 250-cp. lamps, wire and conduit.

MARE ISLAND (VALLEJO), CAL.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 26, for one bucket dredge (electrically operated) for the navy yard, Mare Island, Cal. Drawings and specifications may be obtained on application to the above bureau or to the commandant of the navy yard named.

SAN FRANCISCO, CAL.—The contract for furnishing electric conduit and splicing materials for the Municipal Railway in Twin Peaks tunnel has been awarded to the Standard Underground Cable Company at $32,128.

CASA GRANDE, ARIZ.—Bids will be received by the city clerk of Casa Grande until Feb. 15 for the construction of an electric-light and power plant and water works system in Casa Grande, to cost about $30,000. V. A. Thompson of Phoenix is engineer.

HIGLEY, ARIZ.—The electrical district No. 2 of Higley has been formed and approved by the Board of Supervisors for the county of Maricopa. After estimates have been submitted the proposal to issue bonds for the installation of transmission lines, transformers, etc., will be submitted to the voters. The cost is estimated at $300,000. John A. Germann is chairman of trustees.

BIG SANDY, MONT.—Bids will be received by Hans L. Lehfeldt, clerk, Big Sandy, until March 1 for construction of water supply system, including a pumping station, intake well and pump pit, two 2½-in. centrifugal pumps and motors and a 100 000-gal. steel tank on a 75-ft. steel tower. Bids will also be received at the same date for construction of a sewage disposal system, including disposal plant, one pumping station, with pumps and motors, cast iron force mains and tile collector main, etc. Plans and specifications are on file in the office of the town clerk and copies may be obtained on application to the Miracle Engineering Company, Ford Building, Great Falls, upon deposit of $10.

MISSOULA, MONT.—The City Commissioners have instructed City Attorney Campbell to prepare an ordinance notifying the Missoula Light & Water Company that the city desires to purchase its entire system; also asking the company to file with the city a proposal stating the price, terms and conditions which the company will accept.

WHITEFISH, MONT.—The Great Northern Railroad Company has decided to discontinue its electric power plant in Whitefish, which has been supplying electricity for lamps and motors for its shop, yards and depot at Whitefish. The company, it is understood, has entered into a contract with the Northern Idaho & Montana Power Company to supply energy for its local needs.

DENVER, COL.—Plans have been prepared by E. M. Jackson, illuminating engineer for the Denver Gas & Electric Company, at the request of the Fourteenth Street Improvement Association, for an ornamental lighting system for that thoroughfare from Colfax Avenue to the Platte River viaduct. The standards, which the property owners have agreed to furnish if approved by the Council, will cost $150 each, and carry five lamps. The cost is estimated at $15,000. A general movement has been started among property owners in both downtown and outlying districts for the installation of ornamental lamps throughout the city

LOVELOCK, NEV.—Negotiations are under way between the Louisiana Consolidated Mining Company and the Nevada-California Company of Denver, Col., for the erection of an electric transmission line from Belmont to the old camp of Tybo, a distance of 29 miles. The cost of the work is estimated at about $30,000.

Canada

LADYSMITH, B. C.—The City Council is contemplating the purchase of a transformer for the municipal electric plant and new meters.

GLACE BAY, N. S.—The Dominion Coal Company is reported to be in the market for complete equipment for a 1500-hp. turbine plant. A. J. Tonge is general superintendent.

SYDNEY, N. S.—The Dominion Iron & Steel Company is contemplating the purchase of a 2000-kw. electric generating unit and water tube boilers of 3000 hp. for its mines at Wabana, Newfoundland. Other equipment will be purchased at a total cost of about $1,000,000.

BRANTFORD, ONT.—The wiring and equipment of the Western Counties Electric Company in Brantford Township has been purchased by the township for $4,000, and the Hydro-Electric Power Commission will be asked to proceed at once with the extension of the system to Grandview, Parkdale and Echo Place to supply electrical service to the residents of those townships.

SANDWICH, ONT.—Work will begin, it is reported, on the installation of an ornamental lighting system in the spring. C. R. McColl, 175 Assumption Street, Windsor, is engineer.

SHERBROOKE, QUE.—The City Council is considering a by-law authorizing an appropriation of $500,000 for the purchase of the Two Miles Falls power at Weedon, to develop same and erect an electric transmission line to Sherbrooke. A report submitted by Francis & Company, consulting engineers, Montreal, estimates the cost of developing the power and equipment at $1,452,900.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Feb. 23, for furnishing shop machines, steel cable, bearing metal, brass tubing, oilers, pipe covering, etc., under Circular (No. 1120). Bids will also be received until Feb. 14, under Circular (No. 2103) for furnishing 200 brass cocks and 8000 lb. sheet copper. Blanks and further information relating to these circulars may be obtained at the above office or the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and Fort Mason San Francisco, Cal.

1,213,815. Control System for Railway Air-Compressors; Clinton J. Axtell, Schenectady, N. Y. App. filed Feb. 4, 1916. Utilized on electric railway cars and locomotives.

1,213,818. Composite Armature-Sleeve; Walter J. Bauroth, Columbus, Ohio. App. renewed June 3, 1916. Sufficiently large diameter to admit of the inward projection of the bearings.

1,213,835. Reverse-Current Relay; George A. Burnham, Saugus, Mass. App. filed Jan. 24, 1913. Employment of two differential-coils, the windings of one being wound in the same direction, and the windings of the other being wound in opposite directions.

1,213,837. Signal Device for Telephone Systems; Arthur E. Case, Chicago, Ill. App. filed Jan. 10, 1913. Electrically and not necessarily mechanically connected to a telephone line.

1,213,844. Protective Device; Elmer E. F. Creighton, Schenectady, N. Y. App. filed May 2, 1912. Number of gaps in series prevent flow of current at the normal voltage of the line, but permit an abnormal voltage to discharge through the gaps to ground.

1,213,852. Welding-Machine; John T. Fagan and Cleveland H. Quackenbush, Cleveland, Ohio. App. filed July 27, 1914. Continuously operating automatic machine.

1,213,865. Bridge for Supporting Electric Fixtures; John R. Gunn, Detroit, Mich. App. filed June 7, 1915. Accommodate itself to the varying spaces that are found between joists and studs.

1,213,871. Bipolar-Electrode Electrolyzer; George Grant Hepburn, Charlton-cum-Hardy, Manchester, England. App. filed Aug. 26, 1916. For the electrolysis of the chlorids of the alkali metals.

1,213,872. System of X-Ray-Tube Operation; George R. Hogan and Hector P. MacLagan, Chicago, Ill. App. filed April 13, 1914. More intense X-Ray field is produced with simpler apparatus.

1,213,881. Sheathed Wire and Terminal Therefor; William K. Kearsley, Newark, N. J. App. filed May 23, 1916. For electric heating.

1,213,933. Electric Switch; Harry J. Morey, Syracuse, N. Y. App. filed March 28, 1912. Pull-cord.

1,213,937. Electric-Circuit Breaker; Steffen F. Nielssen, Houston, Tex. App. filed July 7, 1914. Minimum number of parts.

1,213,960. Locking-Switch; Edson O. Sessions, Chicago, Ill. App. filed June 14, 1915. With high-tension circuits.

1,213,963. Recorder for Systems of Electrical Distribution; Harold S. Sines, Chicago, Ill. App. filed Dec. 31, 1915. Improvements.

1,213,975. Projection Apparatus; John B. Taylor, Schenectady, N. Y. App. filed Feb. 17, 1916. Incandescent lamps adapted for utilization with such apparatus.

1,213,981. Toaster; Frederick A. Vollbrecht, Detroit, Mich. App. filed June 19, 1916. Improved construction.

1,214,005. Method of Bonding Rails and Like Conductors; John R. Brown, Mansfield, Ohio. App. filed May 11, 1916. Provide a connection around the adjacent ends of two rails without the use of rivet, bolt, expanding pin, etc.

1,214,011. Scale; Samuel G. Crane, Toledo, Ohio. App. filed Dec. 24, 1913. Having electric lights arranged to illuminate the chart.

1,214,014. Magneto; R. C. Danly. App. filed April 3, 1914. Improvement.

1,214,015. Magneto; Robert C. Danly, Chicago, Ill. App. filed June 28, 1915. With internal combustion engines.

1,214,021. Light or Voltage Regulator; Dwight A. Eaken, Lodi, Ohio. App. filed Dec. 13, 1915. Produce a constant voltage with a variable speed.

1,214,022. Apparatus for Wireless Telegraphy and the Like; Philip E. Edelman, Minneapolis, Minn. App. filed Aug. 19, 1912. Wireless space communication or control.

1,214,029. Maximum-Demand Indicating Instrument; Chester I. Hall, Chicago, Ill. App. filed Oct. 27, 1913. Means employed for permitting the return to zero of the indicator-actuating mechanism at the end of each one of the predetermined time intervals.

Record of Electrical Patents

Notes on United States Patents issued on Jan. 30, 1917.

1,214,053. Incubator; Bayard W. Mendenhall, Salt Lake City, Utah. App. filed Oct. 21, 1914. Plurality of trays may be used.

1,214,058. Vehicle Direction-Indicator; Warren B. Moulton and Edwin W. Moulton, Riverside, Cal. App. filed Jan. 11, 1916. Operated from the driver's seat.

1,214,067. Dynamo-Electric Machine; William H. Powell, Milwaukee, Wis. App. filed Feb. 27, 1915. For supporting brushes of dynamo-electric machines in operative position relatively to commutators and to suitable terminals or cross-connectors.

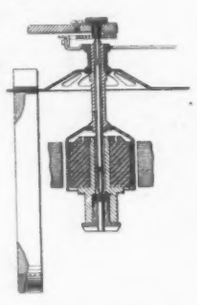
1,214,074. Time-Limit Relay-Switch; Clarence Renshaw, Edgewood Park, Pa. App. filed March 7, 1913. Automatic control of railway motors.

1,214,077. Electric Switch; Joseph Sachs, Hartford, Conn. App. filed Nov. 12, 1914. Improvements.

1,214,078. Meter-Testing Appliances; Joseph Sachs, Hartford, Conn. App. filed May 1, 1915. Improvements.

1,214,079. Convertible Cut-Out Switch; Joseph Sachs, Hartford, Conn. App. filed May 5, 1915. Quickly converted into a meter tesing cut-out switch and service connection appliance.

1,214,081. Centrifugal Switch; Harold M. Scheibe, Cambridge, Mass. App. filed Dec. 19, 1913. With fan motors of the induction type.



1,214,096—Movable Element for Electrical Measuring Instruments

1,214,083. Oil-Circuit Breaker; Hjalmar Rudman Schultz, Trafford Park, Manchester, England. App. filed March 20, 1912. Prevent undue heating of interrupters.

1,214,096. Movable Element for Electrical Measuring Instruments; Samuel Trood, Edgewood Park, Pa. App. filed Feb. 7, 1913. Means for mounting the armature and the damping disk of an instrument upon a shaft in such a manner that the shaft, armature and damping disk may be independently detached from the other component parts without disturbing the aligned and fixed relations thereof.

1,214,101. Hot-Wire Alternating-Current Limiter; Peder Wessel, Ljan, near Christiania, Norway. App. filed March 24, 1915. Hot wire is not exposed to the total electric current consumed.

1,214,116. Rectifier System; Alfred L. Atherton, Wilkinsburg, Pa. App. filed April 1, 1915. Vapor-arc type.

1,214,129. Electrical Protective Device; Harold W. Brown, Ithaca, N. Y. App. filed Jan. 7, 1914. Temperature relays.

1,214,141. Testing Apparatus; Adolph H. Daus, Chicago, Ill. App. filed Aug. 6, 1915. Apparatus for supplying current of various voltages, amperages and periodicities.

1,214,143. Dynamo-Electric Machine; George M. Eaton, Pittsburgh, Pa. App. filed July 6, 1915. Propulsion of electric vehicle.

1,214,183. Electrical Connecting Device; Franz Kratz, Stuttgart, Germany. App. filed April 30, 1914. Adapted for portable batteries in a wood or metal containing box.

1,214,186. Soldering Iron; Robert Kuhn, Detroit, Mich. App. filed Sept. 4, 1915. Electrically heated.

1,214,208. Signal for Moving-Picture Reels; Harry Louis Miller, Pittsburgh, Pa. App. filed June 25, 1915. Warn the operator when the reel is almost emptied of the film.

1,214,210. Storage-Battery Plate; Howard Stanley Mills, Astoria, N. Y. App. filed June 18, 1912. Improved conducting frame or grid.

1,214,214. Generator of High-Frequency Currents; Pder Oluf Pederson and Valdemar Poulsen, Frederiksberg, Denmark. App. filed Jan. 6, 1913. Uniform distribution of the high-frequency energy can be obtained.

1,214,235. Transformer-Secondary; Herbert L. Smith, Westerly, R. I. App. filed May 24, 1916. Secondary of minimum length and resistance.

1,214,258. Telephone System for Toll Traffic; Carolus Robert Hendrik Arntzenius, Hague, Netherlands. App. filed Sept. 19, 1913. Switching system.

1,214,265. Detector for Wireless Systems; Milton Berel and Louis Funke, New York, N. Y. App. filed March 11, 1916. Detectors of the crystal type.

1,214,271. Process of Plating; Lucian W. Bugbee, Southbridge, Mass. App. filed Dec. 4, 1916. Plating of aluminum by electrodeposition.

1,214,280. Electrical System of Distribution; Gorham Crosby, Brooklyn, N. Y. App. filed June 26, 1914. Regulation of variable speed generators, adapted to charge a storage battery.

1,214,283. Wireless Telegraphy; Lee de Forest, Palo Alto, Cal. App. filed Sept. 24, 1912. Antenna systems.

1,214,323. Controller for Heating Systems; Frederick T. Kitchen, West New Brighton, N. Y. App. filed Oct. 3, 1913. Thermostat.

1,214,353. Conduit-Box Receptacle; Harry J. Morey, Syracuse, N. Y. App. filed Sept. 17, 1913. Pull-chain receptacles for use on conduit or outlet boxes.

1,214,355. Motor-Control System; Edwin J. Murphy, Schenectady, N. Y. App. filed May 9, 1911. Actuating windings of the several switches are successively connected in the armature circuit.

1,214,375. Signaling System; Alexander H. Rudd, Media, Pa. App. filed May 26, 1916. Improvements.

1,214,433. Cabinet for Electrical Appliances; Ernest M. Crane and Chauncey R. Pelton, Detroit, Mich. App. filed March 27, 1916. For carrying the electrical appliances and switches used by a dentist.

1,214,439. Socket for Electric Lamps; Laurens P. Dixon, New York, N. Y. App. filed Jan. 6, 1914. Permitting a number of electric lamps to be mounted thereon.

1,214,440. Electric-Trolley-Railway Signal System; Benjamin M. Downs, Buffalo, and Walter S. Cook, Lackawanna, N. Y. App. filed Nov. 17, 1915. One track railway having sidings at intervals.

1,214,459. Protector for Telephone-Mouthpieces; Mary Griffin Heberly, Springville, N. Y. App. filed April 20, 1916. Individual germ proof protector.

1,214,466. Register for Telephone-Calls; Edward Taylor Hull, New York, N. Y. App. filed April 12, 1916. House or other telephone.

1,214,470. Terminal Clip for Electric Conductors; Benjamin A. Jeffery, Detroit, Mich. App. filed Feb. 3, 1912. Insulation surrounding the conductor may be more or less firmly grasped.

1,214,486. Electric Cooking Apparatus; William D. Wright, San Diego, Cal. App. filed Feb. 5, 1916. For grilling and waffle baking.

1,214,492. Telephone System; Alfred H. Dyson, Chicago, Ill. App. filed April 6, 1906. Suitable step-by-step switching mechanism is operated in response to impulses sent over a calling line to automatically select and establish connection with a desired called line and is automatically restored to normal position at the end of conversation.